LDL-Series Ironless Linear Servo Motors

Catalog Numbers
LDL-N030*xxx*-*x*HT11, LDL-N050*xxx*-*x*HT11, LDL-N075*xxx*-*x*HT11,
LDL-T030*xxx*-*x*HT11, LDL-T050*xxx*-*x*HT11, LDL-T075*xxx*-*x*HT11,

LDL-N030*xxx*-*x*HT20, LDL-N050*xxx*-*x*HT20, LDL-N075*xxx*-*x*HT20,
LDL-T030*xxx*-*x*HT20, LDL-T050*xxx*-*x*HT20, LDL-T075*xxx*-*x*HT20,

LDL-N030*xxx*, LDL-N050*xxx*, LDL-N075*xxx*,
LDL-T030*xxx*, LDL-T050*xxx*, LDL-T075*xxx*

User Manual

ALLEN-BRADLEY • ROCKWELL SOFTWARE

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
SHOCK HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

Chapter 5

Wiring the LDL-Series Linear Motor

Chapter 6

Configure and Start Up the LDL-Series Linear Motor

Appendix A

Specifications and Dimensions

Notes:

About This Publication

This manual provides detailed installation instructions for mounting, wiring, and maintaining your LDL-Series Ironless Linear Servo Motors.

Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation, wiring, and maintenance of LDL-Series ironless linear motors.

If you do not have a basic understanding of linear motors, contact your local Rockwell Automation sales representative for information on available training courses before using this product.

Additional Resources

The following documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Kinetix 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001	How to install, setup, and troubleshoot a Kinetix 2000 drive
Kinetix 6000 Multi-axis Servo Drive User Manual, publication 2094-UM001	How to install, setup, and troubleshoot a Kinetix 6000 drive
Ultra3000 Digital Servo Drives Installation Manual, publication 2098-IN003	How to install, setup, and troubleshoot an Ultra3000 drive
Ultra3000 Digital Servo Drives Integration Manual, publication 2098-IN005	
Ultra3000 Digital Servo Drives User Manual, publication 2098-UM001	Instruction on configuring Ultra3000 and Ultra500 drives, creating and configuring project, source, and header files and creating and running programs.
Motion Analyzer CD, download at http://ab.com/e-tools.	Drive and motor sizing with application analysis software
Motion Modules in Logix5000 Control Systems User Manual, publication LOGIX-UM002	Information on configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules, and using the home to torque-level sequence
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise
Kinetix Motion Control Selection Guide, publication GMC-SG001	Information about Kinetix products
Safety Guidelines for the Application, Installation, and Maintenance of Solid State Controls, publication SGI-IN001	Characteristics, application, installation, and maintenance of solid state controls
Allen-Bradley Industrial Automation Glossary, publication AG-7.1	A glossary of industrial automation terms and abbreviations
Rockwell Automation Product Certification Website, publication available at http://www.ab.com	For declarations of conformity (DoC) currently available from Rockwell Automation
National Electrical Code. Published by the National Fire Protection Association of Boston, MA.	An article on wire sizes and types for grounding electrical equipment

You can view or download publications at http://literature.rockwellautomation.com. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Notes:

Safety Considerations

Introduction

This chapter describes the safety issues encountered while using a linear motor and the precautions you can take to minimize risk. Potential hazards discussed here are identified by labels affixed to the device.

Labels

Here you will find the safety and identification labels affixed to your linear motor components. To prevent injury and damage to the linear motor, review the safety label and its details and location before using the linear motor.

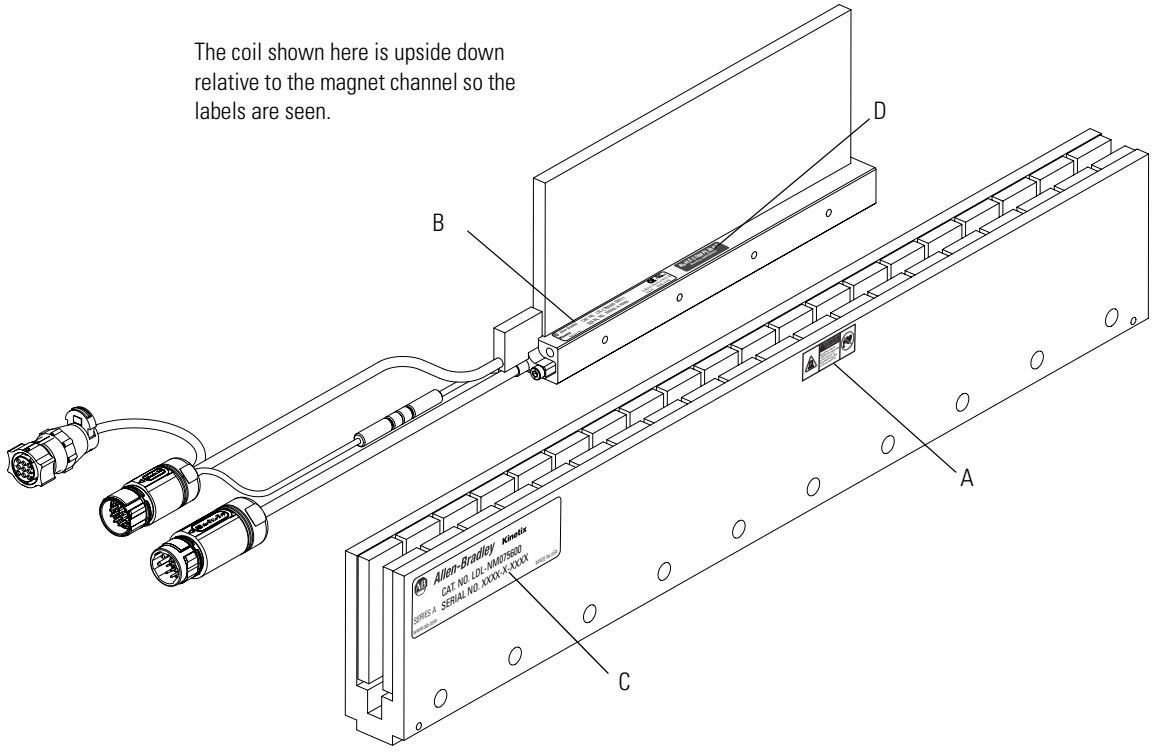
Safety Label

Title	Location	Label	Details
Magnetic Field Danger	A		The Magnetic Fields label identifies non-ionizing radiation found in the magnet channels. Magnetic channels are constructed with strong magnets. Strong magnets can disrupt the functionality of automatic implantable cardioverter defibrillators (AICD); people with a pacemaker should not work near the magnet channels. Maintenance personnel working near the magnet channels should avoid the use of metallic tools and secure items such as badge clip and other personal effects that could be attracted by the strong magnets. Strong magnets can erase magnetic media. Never let credit cards or electronic media contact or come near the magnet channels.

Identification Labels

Title	Location	Label	Details
Coil Name Plate	B	Allen-Bradley Kinetix CAT. NO. LDL-XXXXXXX-XHTXX SERIAL NO. XXXX-X-XXXX	This name plate shows the coil catalog number, serial number operating voltage and frequency.
Magnet Channel Name Plate	C	Allen-Bradley Kinetix CAT. NO. LDL-XXXXXXXXX SERIAL NO. XXXX-X-XXXX www.ab.com MADE IN USA	This name plate shows the magnet channel catalog number, serial number.
RoHS Compliant	D	RoHS COMPLIANT Directive 2002/95/EC	LDL-Series linear motor components are RoHS compliant.

Label Locations for LDL-Series Linear Motor



High Energy Magnets

Linear motor magnet channels contain high energy magnets that attract ferrous metals from a considerable distance. Precautions must be taken while unpacking, handling, and shipping by air.

Unpacking and Handling

Unpack magnet channels one at a time. Repack magnet channels after inspection and before it is stocked or staged for installation. Leave

protective wrapping, cardboard and flux containment plates in place until magnet channel is installed. Clear the inspection and repacking area of any ferrous metals that will attracted to or attract the magnetic assembly. If magnet channels must be unpacked at the same time maintain a distance of 1.5 m (5 ft) between assemblies.

Air Freight Restrictions

When air freighting linear motor special preparations and precautions must be taken. The following information outlines the basic requirements at the publication date of this document. However, regulations are subject to change and additional area or carrier restrictions may be imposed. Always check with your carrier or logistics specialist regarding current local, regional, and national transportation requirements when shipping this product.

Linear motor magnet channels contain magnetized material, as classified by International Air Transport Association (IATA) Dangerous Goods Regulations. An IATA trained individual must be involved when shipping this product via domestic or international air freight. Packing Instruction 902 provides information regarding the preparation of this product for air transportation. Follow these regulations for general marking and labeling requirements, the application of specific Magnetized Material Handling Labels, and instructions for preparing the Shipper's Declaration for Dangerous Goods.

As a minimum, refer to the following IATA Dangerous Goods Regulations:

- Subsection 1.5: Training
- Subsection 3.9.2.2: Classification as Magnetized Material
- Subsection 4.2: Identification as UN 2807, Magnetized Material, Class 9, Packing Instruction 902
- Subsection 7.1.5: Marking
- Subsection 7.2: Labeling
- Subsection 7.4.1: Magnetized Material Label
- Section 8: Shipper's Declaration for Dangerous Goods

When shipped via ground in the United States, these products are **not** considered a U.S. D.O.T. Hazardous Material and standard shipping procedures apply.

Vertical or Incline Installation

A linear motor driven system mounted vertically or on an incline will not maintain position when the power is removed. Under the influence of gravity the motion platform and its payload will fall to the low end of travel. Design engineers should allow for this by designing in controlled power down circuits or mechanical controls to prevent the linear motor driven system and its payload from being damaged when the power fails.

ATTENTION

Linear motors are capable of high accelerations, sudden and fast motion. Rockwell Automation is not responsible for misuse, or improper implementation of this equipment.

ATTENTION

Linear motor driven systems must have end of travel bumpers. They must be designed to take a large impact from uncontrolled motion. The payload must be secured to the system such that it will not sheer off in the event of an impact in excess of the bumper ratings.

ATTENTION

The Hall effect module contains an electrostatic discharge (ESD) sensitive devise. You are required to follow static-control precautions when you install, test, service, or repair this assembly. If you do not follow ESD control precautions, components can be damaged. If you are not familiar with static control precautions, refer to Guarding Against Electrostatic Damage, publication 8000-4.5.2, or any other applicable ESD awareness handbook.

BURN HAZARD

When the linear motors are running at their maximum rating the temperature of attached heat sink can reach 100 °C (212 °F).

SHOCK HAZARD

An assembled linear motor will generate power if the coil or magnet channel is moved. Un-terminated power cables present an electrical shock hazard. Never handle flying leads or touch power pins while moving the motor.

Operational Guidelines

Please read and follow the guidelines shown here to safely operate the linear motor created from the these linear motor components.

ATTENTION

Observe maximum safe speed. Linear motors are capable of very high forces, accelerations, and speeds. The maximum obtainable acceleration and speed is based on the drive output (bus voltage and current settings). The allowable maximum speed is application specific and partly based on the linear motion mechanics supplied by others.

ATTENTION

Moving parts can cause injury. Before operating the linear motor, make sure all components are secure and magnet mounting hardware is below magnet surface. Remove all unused parts from the motor travel assembly to prevent them from jamming in the motor air gap and damaging the coil or flying off and causing bodily injury.

IMPORTANT

You are responsible for making sure the servo control system safely controls the linear motor with regards to maximum safe force, acceleration, and speed, including runaway conditions.

A runaway condition can be caused by incorrect motor, hall effect, and position feedback wiring resulting in violent uncontrolled motion.

ATTENTION

Keep away from the line of motor travel at all times. Always have bumpers in place and securely fastened before applying power to your linear motor.

ATTENTION

High Voltage can kill. Do not operate with exposed wires. Do not go near electrically live parts.

WARNING

Large Position Error Tolerances, such as those calculated by the Auto Tune function in RSLogix 5000 programming software, or when configuring a new axis with RSLogix 5000 software, can lead to undetected and repetitive high energy impacts against axis end stops if proper precautions are not in place. These tolerances can also lead to undetected and repetitive high energy impacts against unexpected obstructions. Such impacts can lead to equipment damage and/or serious injury.

To identify the safety concerns that you have with default Position Error Tolerance or after an Auto-Tune Function go to the Rockwell Automation Knowlegebase. Click on Find Technical Support Answers and search for Answer Id 55937.

Start

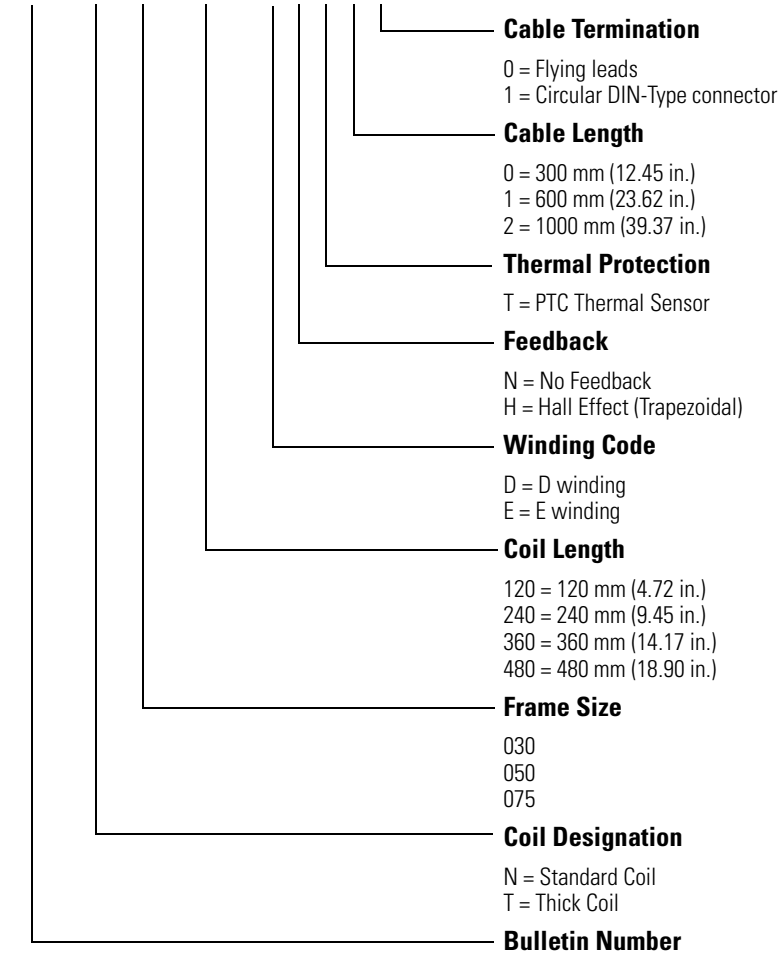
Introduction

Use this chapter to become familiar with the linear motor components, their maintenance needs, and their configuration.

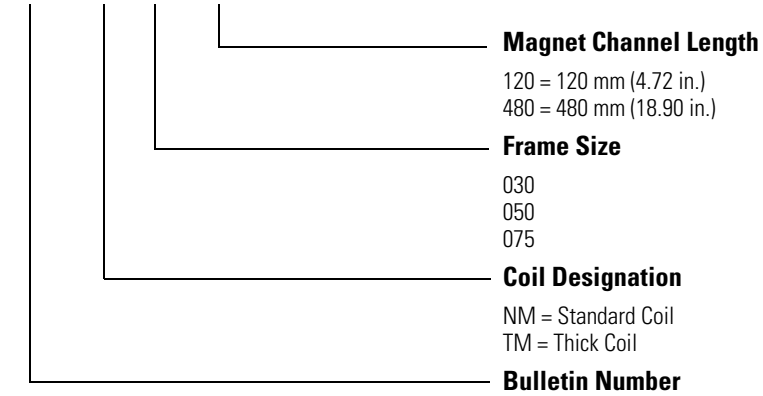
Catalog Number Explanation

An ironless linear motor is comprised of a coil and a magnet channel. The following keys show the catalog definition for the linear motors.

LDL - *x xxx xxx - x x x x x*



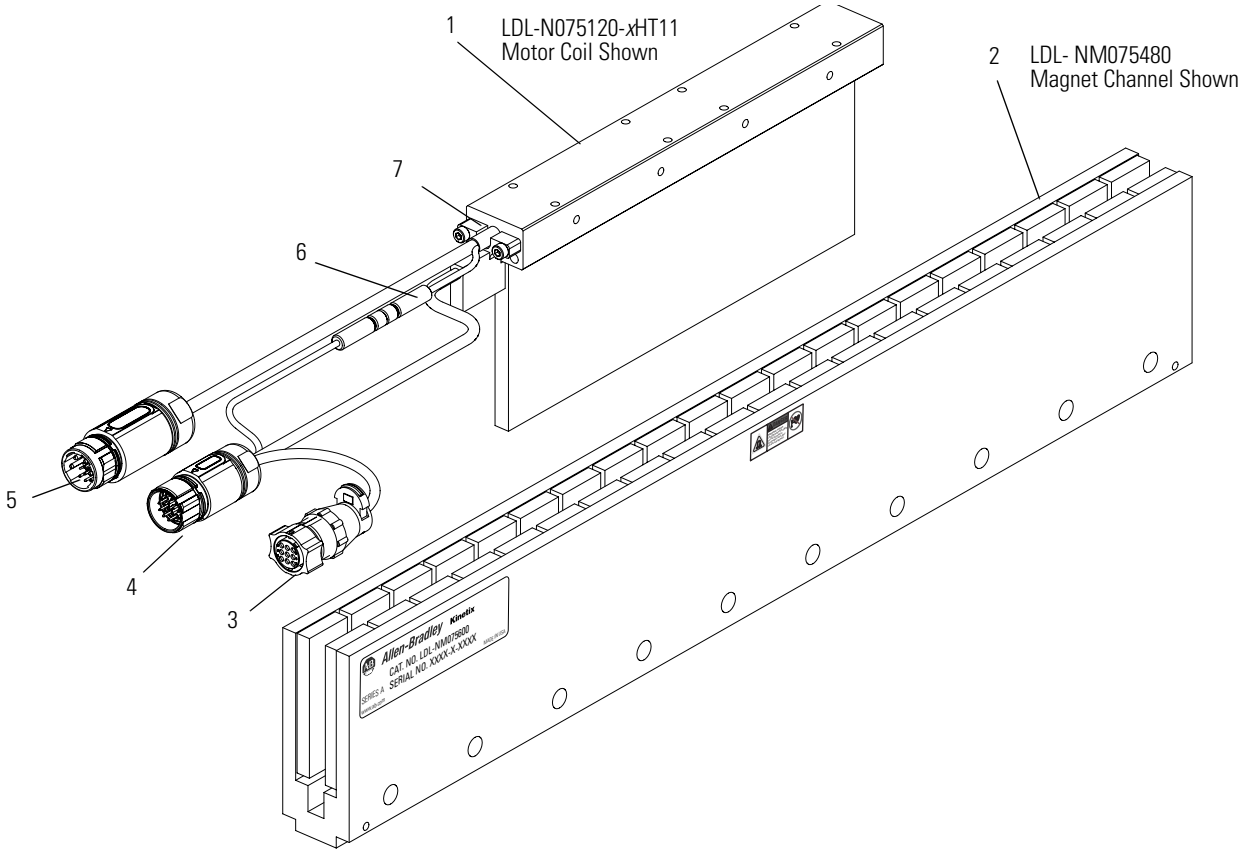
LDL - *xx xxx xxx*



Linear Motor Components

Use the diagrams and descriptions to identify the unique components of the linear motor.

Components of Ironless Linear Motor Coil and Magnet Channel



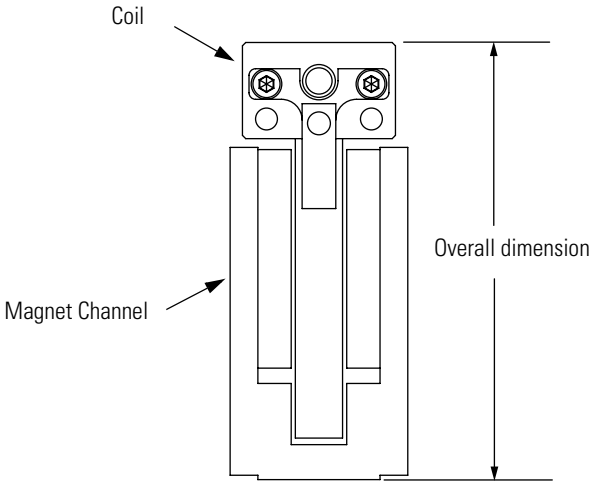
Component Number	Component	Description
1	Ironless motor coil	Copper coils contained in an epoxy form. When powered, the coil interacts with the magnet channel.
2	Magnet channel	High powered static magnets create the flux field the powered coil interacts with.
3	Encoder connector	Connect your encoder here using connector kit, catalog number LDC-ENC-CNCT.
4	Feedback connector	Connect to your drive feedback using either catalog number 2090-CFBM4DF-CDAF*xx* (for moving coil) or 2090-XXNFMF-S*xx* (for moving magnet).
5	Power connector	Connect to your drive power using either catalog number 2090-CPWM4DF-*xx*AF*xx* (for moving coil) or 2090-XXNPMF-*xx*S*xx* (for moving magnet).
6	Thermistor connector	Connects the PTC thermistor signal to the feedback connector.
7	Hall effect module	This module provides input signals for commutation start-up. Replacement catalog numbers for the Hall effect module are LDL-HALL-C for LDL-*xxxxxxx*-*x*HT11 and LDL-HALL-F for LDL-*xxxxxxx*-*x*HT20.

Design Consideration

The information provided here is critical to using linear motor components. Design your system to comply with the following points to run safe and successfully.

Motor Air Gap

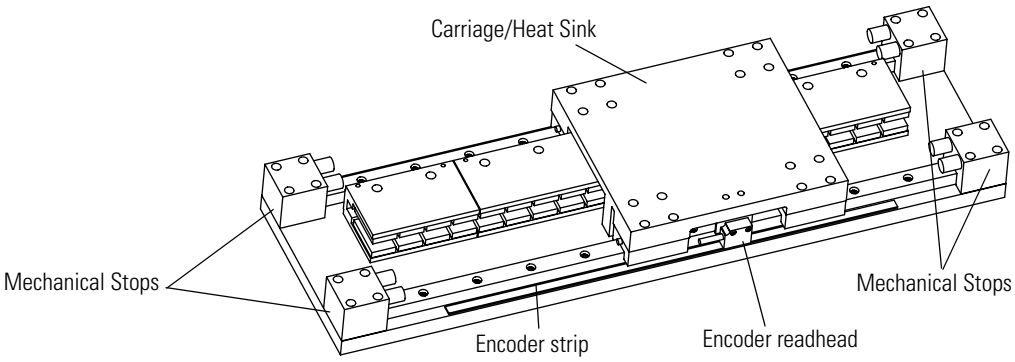
Maintaining the air gap is critical to proper installation and operation of the linear motor components. Use the coil, and magnet drawings in Appendix A to calculate the installation envelope dimension. By maintaining installation envelope dimension in your design the vertical air gap requirement will be met. The following diagram shows the critical dimensions.



Bumpers, Shock Absorbers, or End Stops

Always include in your design a mechanical stop at the ends of travel. Designed them such that they can prevent the moving mass from leaving its travel limits. Take into consideration the maximum speed and inertia of your moving mass when designing your mechanical

stops. The following diagram shows a minimal system with mechanical stops.



Linear Encoder

Your linear motor components needs to be integrated with a linear encoder purchased from a third party.

Carriage/Heat Sink

The linear motor coil requires a heat sink to maintain performance. The heat sink requires a minimal mass and surface area as shown on page 62. It can as so serve as the carriage in moving coil system or be designed into the base in moving magnet system.

Maintenance

Linear motors require no maintenance when operated in a relatively clean environments. For operation in harsh and dirty environments, minimal cleaning is recommended every 6 months.

Clean the metallic debris and other contaminants from the air gap. Use a strip of masking tape to effectively remove the metal debris. Apply a strip of tape in the magnet channel and then remove it.

Motor Storage

Motor storage area should be clean, dry, vibration free, and have a relatively constant temperature. If a motor is stored on equipment, it should be protected from the weather. All motor surfaces subject to corrosion should be protected by applying a corrosion resistant coating.

Notes:

Installing the LDL-Series Linear Motor

Introduction

The following section shows you how to safely unpack and install your linear motor components.

Unpacking and Inspection

Inspect motor assemblies for damage that may have occurred in shipment. Any damage or suspected damage should be immediately documented. Claims for damage due to shipment are usually made against the transportation company. Contact Rockwell Automation immediately for further advise.

ATTENTION

Linear motors contain powerful permanent magnets which require extreme caution during handling. When handing multiple magnet channels do not allow the channels to come in contact with each other. Do not disassemble the magnet channels. The forces between channels are very powerful and can cause bodily injury. Persons with pacemakers or Automatic Implantable Cardioverter Defibrillator (AICD) should maintain a minimum distance of 0.33 m (1 ft) from magnet assemblies. Additionally, unless absolutely unavoidable, a minimum distance of 1.5 m (5 ft) feet must be maintained between magnet assemblies and other magnetic or ferrous composite materials. Use only non-metallic instrumentation when verifying assembly dimension prior to installation

- Compare the purchase order with the packing slip.
- Check the quantity of magnet channels received matches your job requirements.
- Identify the options that came with your linear motor.
- Inspect the assemblies and confirm the presence of specified options.

Installing the Linear Motor Components

Use the following procedures to install the magnet channel and the motor coil.

Required Tools:

- Aluminum straight edge
- Non-magnetic M4 or M5 hex wrench
- Magnet channel alignment tool

IMPORTANT The alignment tool is shipped attached to the cables next to the Hall effect module. Remove before operating the linear motor.

TIP Non-magnetic tools and hardware made of beryllium copper, 300 series stainless steel, and others should be used. If not available, proceed carefully since magnetic and ferrous items will be attracted to the magnet channel.

Mount the Magnet Channel

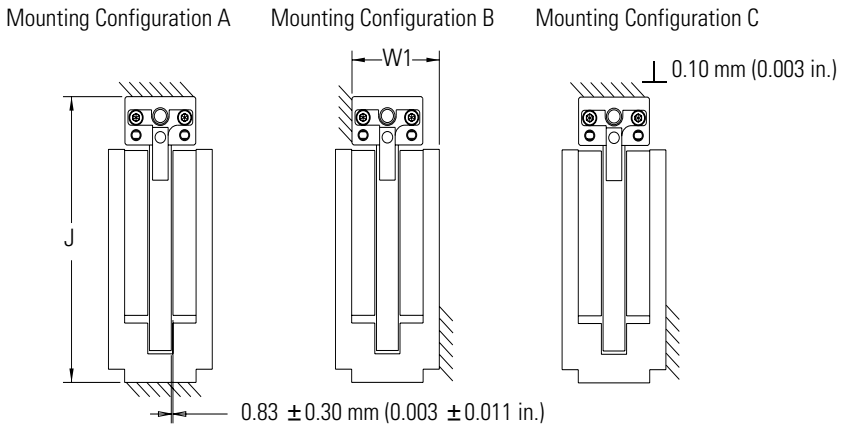
1. Select screw size and quantity.

   The size of the Socket Head Cap Screw (SHCS) depends on mounting configuration. The diagram shows three ways you can mount your linear motor components. Mounting configuration B de-rates the motor continuous force by 10%. See Appendix A starting on page 66 for SHCS quantity.

Mounting Configuration	Require SHCS	SHCS Torque	
		Black Oxide Steel N•m (lb•ft)	**Stainless Steel** N•m (lb•ft)
A	M6	16.0 (11.8)	10.8 (8.0)
B and C	M5	9.5 (7.0)	6.36 (4.7)

2. Verify installation envelope dimensions.

See table on page 23.

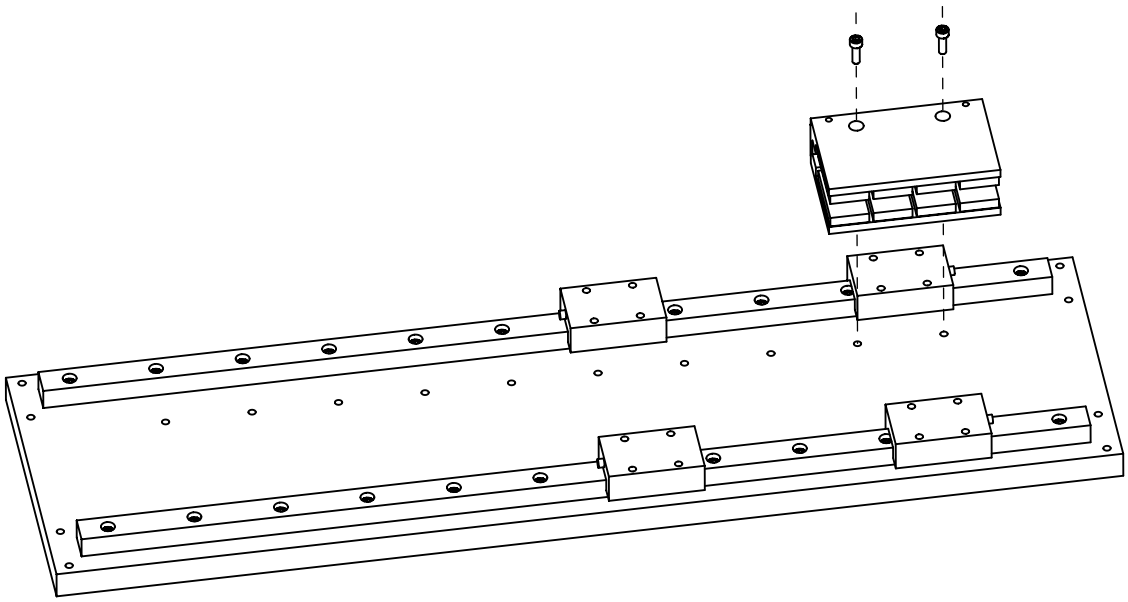


Coil Cat. No.	Dimension H mm (in.)
LDL-*x* 030*xxx-xxxxx*	80.0 (3.15)
LDL-*x* 050*xxx-xxxxx*	100.0 (3.94)
LDL-*x* 075*xxx-xxxxx*	130.0 (5.12)

Magnet Channel Cat. No.	Dimension W mm (in.)
LDL-NM030*xxx* LDL-NM050*xxx*	36.4 (1.43)
LDL-TM030*xxx* LDL-TM050*xxx*	37.7 (1.48)
LDL-NM075*xxx*	38.05 (1.50)
LDL-TM075*xxx*	39.35 (1.55)

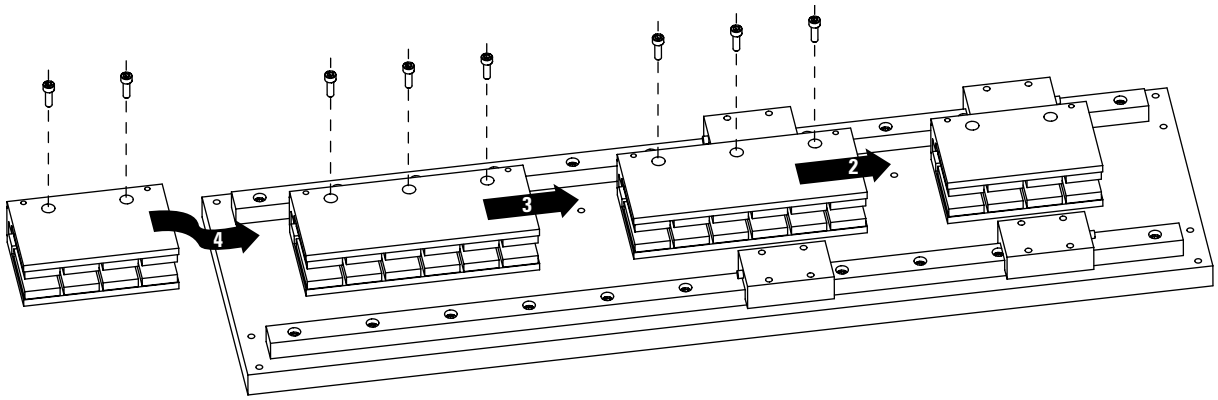
3. Install the first magnet channel.

Tighten but do not torque screws.



4. Install additional magnet channels.

Place a magnet channel on the mounting surface at a distance from the previously installed magnet channel and slide it into position.

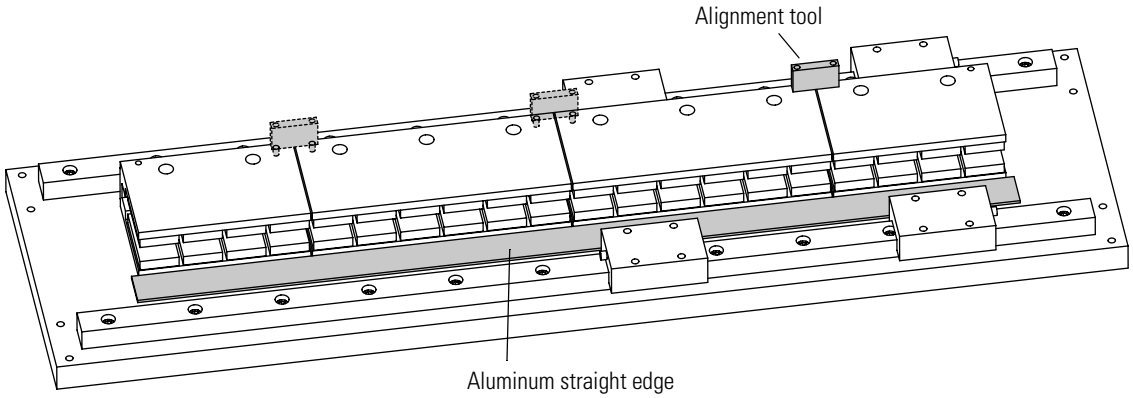


5. Align the magnet channels with an aluminum straight edge and the alignment tool and tighten the screws.

a. Place the alignment tool in the alignment hole at the butting end of the first two magnet channels.

b. Align the edges of the magnet channel with the aluminum straight edge and tighten the screws.

c. Repeat alignment between the fixed magnet channel and the next magnet channels needing alignment until all the magnet channels are tightened.



6. Torque all the screws to values listed in the table on page 22.

7. Remove the alignment tool.

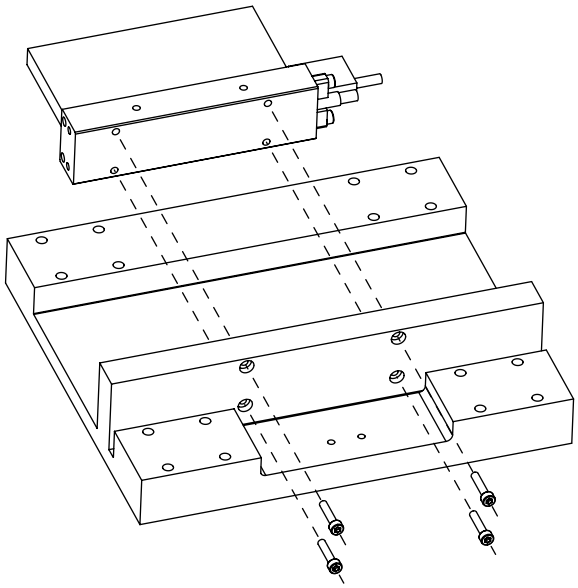
Mount the Motor Coil

Use M4 x 0.7 screws with a length that extends through the carriage mounting surface by minimum of 5 mm (0.197 in.), but not more than 7 mm (0.276 in.).

Follow these steps to mount the motor coil.

1. Clean and remove burrs from the coil mounting surface.
2. Attach the motor coil to the carriage using M4 x 0.7 screw.

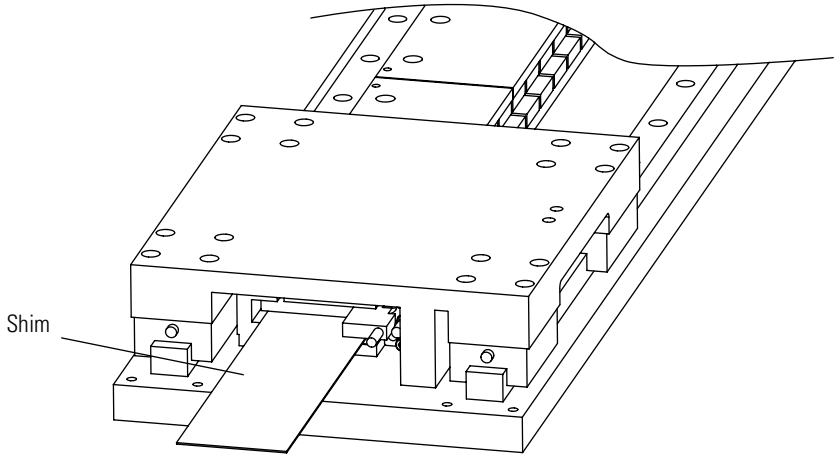
   Lightly tighten the screws.



3. Slide the assembly on to the bearings.

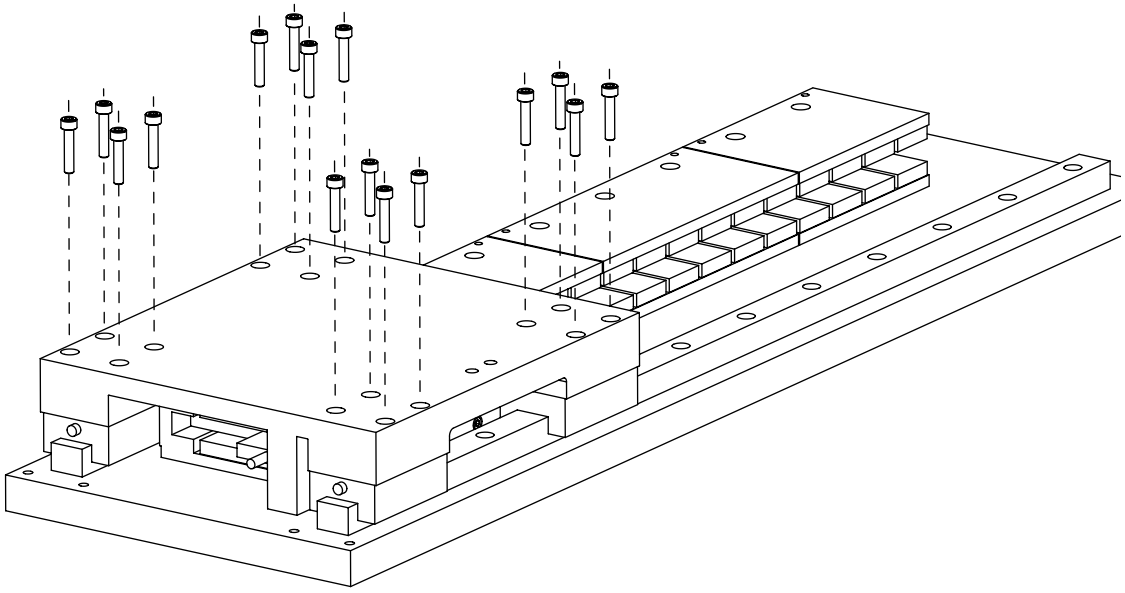
4. Verify the gap between the motor and the magnet channel is 0.83 ±0.30 mm (0.033 ±0.011 in.).

Use plastic shim stock and adjust as necessary.



5. Torque the M4 SCHS to 4.6 N•m (3.4 lb•ft) for black oxide steel screw or 3.10 N•m (2.3 lb•ft) for stainless steel screws.

6. Install the bearing fasterners.



7. Secure the assembly using all the mounting holes.

LDL-Series Linear Motor Connector Data

Introduction

This chapter provides power, thermistor, and Hall effect cable connector information for the linear motor coil and Hall effect module.

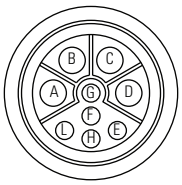
Linear Motor Coil Connectors

There are two connectors on the linear motor coil, catalog number LDL-*xxxxxxxx-xx*T11, the power and the Positive Temperature Coefficient (PTC) thermistor.

Power Connector

The following tables identify the power signals for DIN style circular connector.#

Pin	Color	Signal
A	Red	U (A) Phase
B	White	V (B) Phase
C	Black	W (C) Phase
D	Green/Yellow	Ground
Case	Shield	Cable Shield and GND



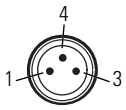
Intercontec P/N BKUA090NN00420220000
Mating Connector Kit Allen-Bradley 2090-KPBM4-12AA

ATTENTION

Properly ground the coil as described in this manual and the drive manual.

PTC Thermistor Connector

Pin	Description	Signal
1	Positive Temperature Coefficient (PTC) thermistor +	TS+
3	Positive Temperature Coefficient (PTC) thermistor -	TS-
4	–	Reserved



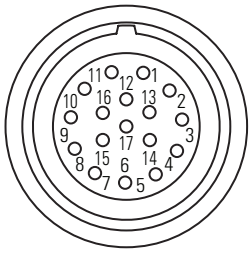
Mates with PTC thermistor connector on Hall effect module.

Hall Effect Module Connectors

The following tables show the pinouts the Hall effect module.

Feedback Connector

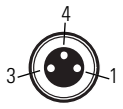
Pin	Description	Signal
1	A Quad B TTL (1 V p-p), + A Differential	AM+ (SIN+)
2	A Quad B TTL (1 V p-p), - A Differential	AM- (SIN-)
3	A Quad B TTL (1 V p-p), + B Differential	BM+ (COS+)
4	A Quad B TTL (1 V p-p), - B Differential	BM- (COS+)
5	TTL + Index Mark Differential	IM+
6	TTL - Index Mark Differential	IM-
7	Reserved	–
8		
9	Encoder and Hall Sensor Power	+5V DC
10	Common	Common
11	Reserved	–
12	Common	Common
13	PTC Thermistor	PTC Temp+
14	PTC Thermistor	PTC Temp-
15	TTL - Trapezoidal Hall Commutation	S1
16	TTL - Trapezoidal Hall Commutation	S2
17	TTL - Trapezoidal Hall Commutation	S3
Case	Shield	–



Intercontec P/N AKUA015NN00400220000
Mating Connector Kit Allen-Bradley 2090-KFBM4-CAAA

PTC Thermistor Connector

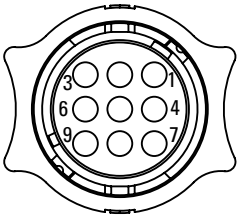
Pin	Description	Signal
1	Positive Temperature Coefficient (PTC) thermistor +	TS+
4	Reserved	–
3	Positive Temperature Coefficient (PTC) thermistor -	TS-



Mates with PTC thermistor connector on linear motor coil.

Encoder Connector

Pin	Description	Signal
1	A Quad B TTL, + A Differential	AM+
2	A Quad B TTL, + B Differential	BM+
3	TTL + Index Mark Differential	IM+
4	A Quad B TTL, - A Differential	AM-
5	A Quad B TTL, - B Differential	BM-
6	TTL - Index Mark Differential	IM-
7	5V DC Return	Common
8	Encoder and Hall Sensor Power	+5V DC
9	Shield Drain	–



Mating connector available a part of encoder connector kit catalog number LDC-ENC-CNCT.

Notes:

Wiring the LDL-Series Linear Motor

Introduction

This section shows you how to wire your LDL-Series linear motor.

Connect the Linear Motor Coil

Use the following procedure to connect your linear motor, catalog number LDL-*xxxxxxx*-*x*HT11.

1. Using the Encoder Connector Kit, catalog number LDC-ENC-CNCT, and the connector data on page 29, wire your encoder to the connector.

ATTENTION

Be sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors. Use Bulk Head Connector Kit, catalog number LDC-BULK-HD, for mounting these connectors.

Excessive and uneven lateral force at the cable connectors may result in the connector's environmental seal opening and closing as the cable flexes.

Failure to observe these safety precautions could result in damage to the motor and its components.

2. Connect your encoder to the encoder connector on the Hall effect module.

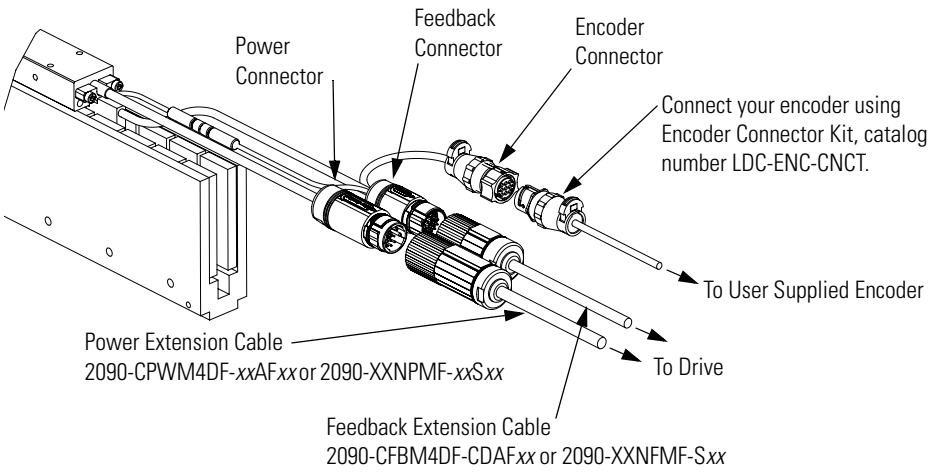
3. Attach the feedback and the power cables.

ATTENTION

Do not connect or disconnect the motor feedback cable or the power cable while power. It may result in unexpected motion or cause damage to the components.

d. Align flats on each connector.

e. Do not apply excessive force when mating the cable and motor connectors. If the connectors do not go together with light hand force, realign and try again.



ATTENTION

Be sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors. Excessive and uneven lateral force at the cable connectors may result in the connector's environmental seal opening and closing as the cable flexes. Failure to observe these safety precautions could result in damage to the motor or encoder.

f. Hand tighten the knurled collar with five to six turns to fully seat the connector.

ATTENTION

Keyed connectors must be properly aligned and hand-tightened the recommended number of turns.

Improper alignment is indicated by the need for excessive force, such as the use of tools, to fully seat connectors.

Connectors must be fully tightened for connector seals to be effective.

Failure to observe these safety precautions could result in damage to the motor, cables, and connector components.

Signal and Wire Definitions for Flying Lead Components

For linear motors, catalog numbers LDL-*xxxxxxx*-*x*HT20, wire using wiring diagram on page 70. Wire colors and signal types are shown here, for wire gauge information see page 65.

Linear Motor Coil

The following shows the wire color and signals for the linear motor coil power and PTC thermistor cables, catalog number LDL-*xxxxxxx*-*xx*T20.

Power Signals

Color	Signal	Comments
Red	Motor Phase U (A)	• Observe maximum applied voltage specification. • Consult drive manual or supplier for specific wiring instructions to the drive. Wiring is phase/commutation sensitive.
White	Motor Phase V (B)	
Black	Motor Phase W (C)	
Green	Motor Ground	• Terminate per drive manual instructions. • Shield is not connected to the motor frame.
Shield	Cable Shield	

ATTENTION

Disconnect input power supply before installing or servicing motor.

Motor lead connections can short and cause damage or injury if not well secured and insulated.

Insulate the connections, equal to or better than the insulation on the supply conductors.

Properly ground the motor per selected drive manual.

PTC Thermistor Signals

Color	Description	Signal
Black	Positive Temperature Coefficient (PTC) thermistor +	TS+
Black	Positive Temperature Coefficient (PTC) thermistor -	TS-

Hall Effect Module

This table shows the signal and wire colors for Hall effect module with flying leads, catalog number LDL-HALL-F.

Color	Signal	Signal Spec
Red	+V	5…24V DC Hall supply, 20 mA.
Black	VRTN	Hall effect signal common.
White	S1	–
Blue	S2	
Orange	S3	
Silver braid	Cable shield	Terminate at drive end per drive manual instructions.

Making Your Own Extension Cables

Flying lead coil and Hall effect modules require circular DIN style connectors to interface with Allen-Bradley extension cables. The following connectors kits are available for terminating flying lead coils and Hall effect modules.

Connector Kit Cat. No.	Application
2090-KFBM4-CAAA	Feedback flex extension cable
2090-KPBM4-12AA	Power flex extension cable
2090-KFBE7-CAAA	Feedback non-flex extension cable
2090-KPBE7-12AA	Power non-flex extension cable

The cable length from the coil to drive should be limited to 10 m (32.8 ft). If longer cables are necessary a 1321-3R*x*-*x* series line reactor is required. Refer to 1321 Power Conditioning Products Technical Data, publication 1321-TD001, to choose a line reactor for applications requiring cable longer than 10 m (32.8 ft).

Mounting and Wiring Two Identical Coils in Tandem

This type of installation requires custom motor database file which is available upon request. Contact Application Engineering at 631.344.6600 to request this file.

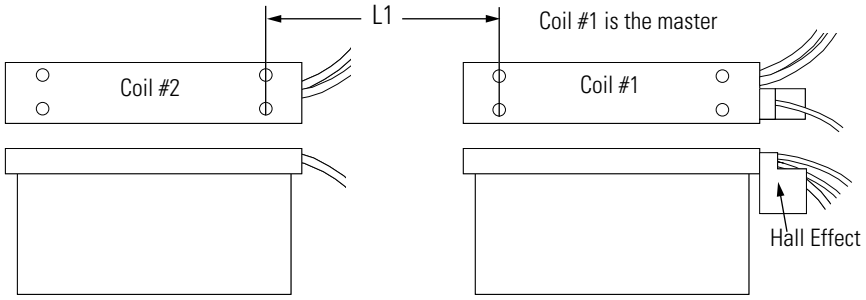
The following tables and diagrams show the wiring and spacing for two identical coils mechanically top mounted(1) to the same plate and driven by one amplifier. There are three configurations shown here for mounting motors in tandem: power and encoder cables exiting on the right, the center, and on opposite ends.

ATTENTION

Coils must have identical part numbers. Using mis-matched coils will cause a hazardous condition resulting in damage to the equipment and a possible fire.

Cables Exit to the Right

If mounting coils in tandem, such that the power cables exit both of the coils on right side as shown, use the following table to find mounting distance and phase wiring.



Phase Wiring for Right Exit Power Cables

L1 mm (in.)	**Coil # 1 Master(1)**	**Coil # 2 Slave(2)**	**Amplifier Phase**
80 (3.15)	Red	White	U
	White	Black	V
	Black	Red	W
120 (4.72)	Red	Black	U
	White	Red	V
	Black	White	W

(1) Contact Application Engineering (631.344.6600) for side mounting of the coils.

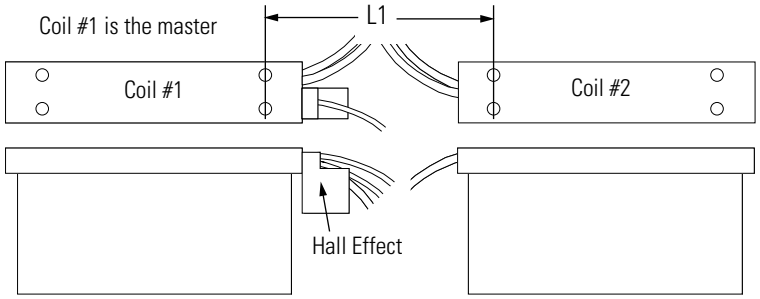
Phase Wiring for Right Exit Power Cables

L1 mm (in.)	**Coil # 1 Master(1)**	**Coil # 2 Slave(2)**	**Amplifier Phase**
160 (6.30)	Red	Red	U
	White	White	V
	Black	Black	W

(1) Master has Hall effect module.
(2) Slave has no Hall effect module.

Cables Exit in the Center

If mounting coils in tandem, such that the power cables exit in the center, as shown, use the following table to find mounting distance and phase wiring.



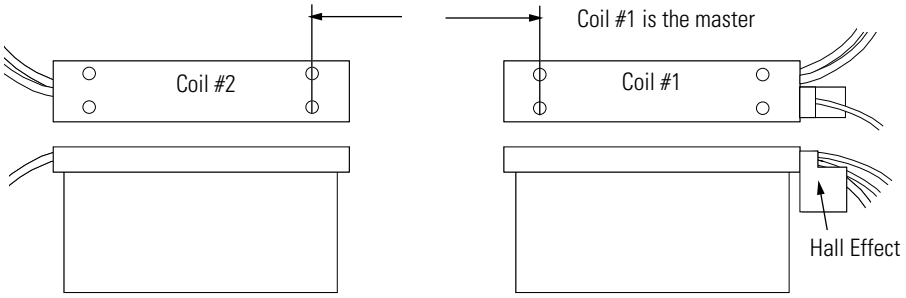
Phase Wiring for Center Exit Power Cables

L1 mm (in.)	**Coil # 1 Master(1)**	**Coil # 2 Slave(2)**	**Amplifier Phase**
90 (3.54) or 150 (5.91)	Red	White	U
	White	Red	V
	Black	Black	W

(1) Master has Hall effect module.
(2) Slave has no Hall effect module.

Cables Exit on Opposite Ends

If mounting coils in tandem, such that the power cables exit opposite to each other, as shown, use the following table to find mounting distance and phase wiring.



Phase Wiring for Opposite End Exit Power Cables

L1 mm (in.)	**Coil # 1 Master**[1]	**Coil # 2 Slave**[2]	**Amplifier Phase**
90 (3.54) or 150 (5.91)	Red	Red	U
	White	Black	V
	Black	White	W

(1) Master has Hall effect module.

(2) Slave has no Hall effect module.

Notes:

Configure and Start Up the LDL-Series Linear Motor

Introduction

This section covers the setup and connection verification of a linear motor with either Kinetix 6000, Kinetix 2000, or an Ultra3000 drive.

Before You Begin

This chapter assumes you have wired your linear motor and Allen-Bradley drive as shown on wiring diagrams in Appendix B starting on page 67.

IMPORTANT It is important that the motor be wired correctly to get positive motion when commutated.
Please read and understand Motor Direction Defined.

Motor Direction Defined

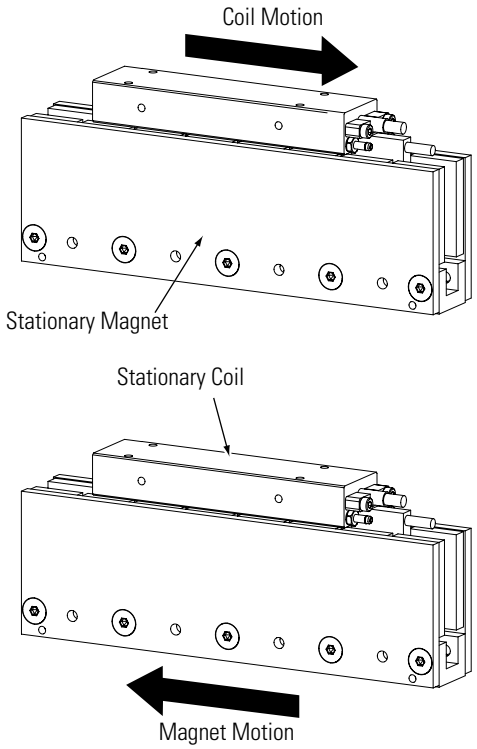
Positive motion is dependent on encoder orientation, encoder wiring, and coil or magnet channel motion.

Most linear encoders are installed with the encoder cable facing the same direction as the coil cable.

Wire the linear encoder such that the position feedback is positive (phase A+ leads phase B+) when the motor is moving in the positive direction.

When the motor power and Hall sensor wiring is connected as shown in wiring diagrams in Appendix B, the positive direction of motion is defined as the motor coil moving toward its power cable. This diagram shows positive motion for both a moving coil and a moving magnet channel.

Motor Direction



What You Need

You need a computer with RSLogix 5000 software installed and internet access.

Required Files

Firmware revisions and software versions required to support the linear motors include the following:

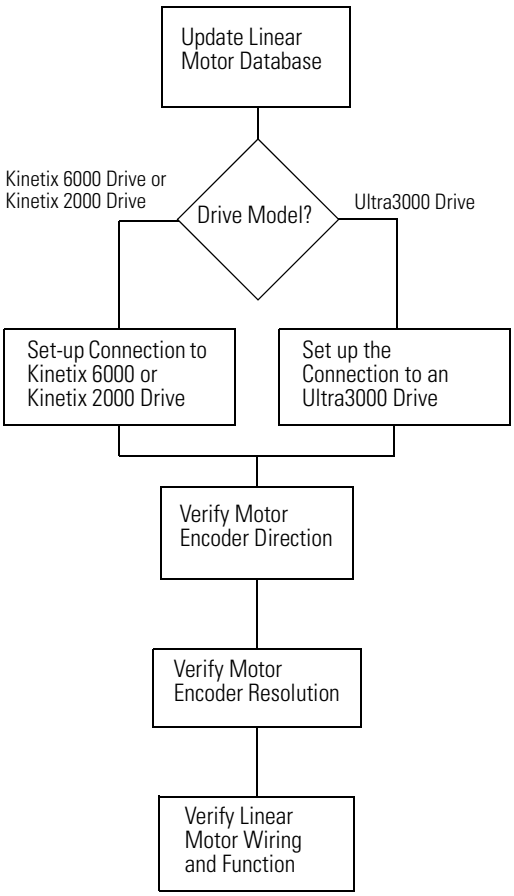
- RSLogix 5000 software, version 16.00 or later
- Kinetix 2000 or Kinetix 6000 multi-axis drives
  - Firmware revision 1.96 or later
  - For RSLogix 5000 software, version 16.*xx* use Motion Database file, version 4_17_0 or later

  - For RSLogix 5000 software, version 17.*xx* or later use Motion Database file, version 5_8_0 or later
- Ultra3000 drives
  - Firmware revision 1.52 or later
  - Motor Database, motor_03_18_09.mdb or later
- Motion Analyzer software, version 4.7 or later

Download these files from http://support.rockwellautomation.com. Contact Rockwell Automation Technical Support at 440.646.5800 for assistance.

Follow These Steps

The following flow chart illustrates the required steps.



Update Linear Motor Database

Install the current Motion Database, as required, before commissioning your linear motor. See the Required Files on page 40.

Set Up the Connection to Kinetix 6000 or Kinetix 2000 Drive

This procedure configures the Kinetix 6000 or Kinetix 2000 drive for your linear motor and encoder combination.

For help using RSLogix 5000 software as it applies to setting up your linear motor, refer to Additional Resources on page 7. This procedure assumes you are familiar with RSLogix 5000 software.

1. Click the Driver/Motor tab.

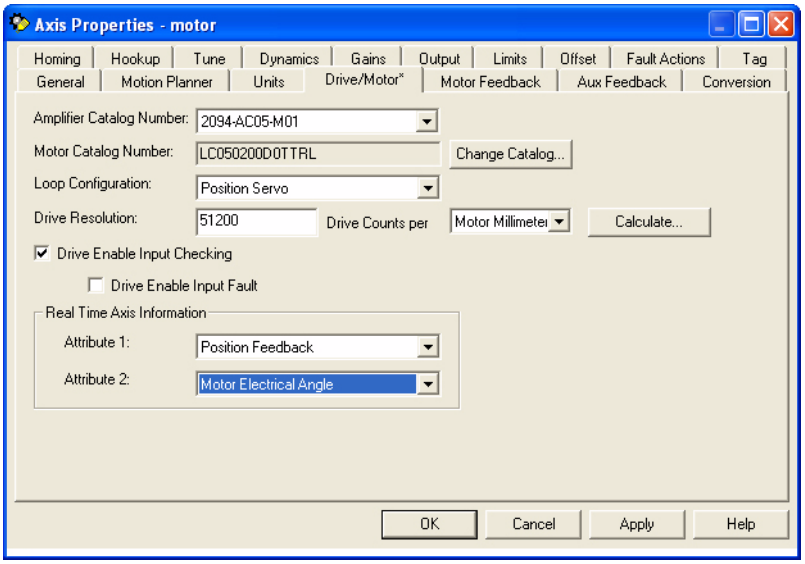
2. Click Change Catalog and select the appropriate Motor Catalogue Number from the following list.

Cat. No.
LDL-N030120-DHT*xx*
LDL-N030240-DHT*xx*
LDL-N030240-EHT*xx*
LDL-T030120-DHT*xx*
LDL-T030240-DHT*xx*
LDL-T030240-EHT*xx*
LDL-N050120-DHT*xx*
LDL-N050240-DHT*xx*
LDL-N050240-EHT*xx*
LDL-N050360-DHT*xx*
LDL-N050360-EHT*xx*
LDL-N050480-DHT*xx*
LDL-N050480-EHT*xx*
LDL-T050120-DHT*xx*
LDL-T050240-DHT*xx*
LDL-T050240-EHT*xx*
LDL-T050360-DHT*xx*
LDL-T050360-EHT*xx*
LDL-T050480-DHT*xx*
LDL-T050480-EHT*xx*
LDL-N075480-DHT*xx*
LDL-N075480-EHT*xx*
LDL-T075480-DHT*xx*
LDL-T075480-EHT*xx*

3. Using the screen image as a reference, configure the parameters as shown in the Setting column.

Parameter	Setting	Comment
Loop Configuration	Position Servo	–
Drive Resolution	200	5 µm encoder
	500	2 µm encoder
	1000	1 µm encoder
	2000	0.5 µm encoder
	51200	20 µm pitch Sin/Cos encoder(1)
	25600	40 µm pitch Sin/Cos encoder
Drive Counts per	Motor Millimeter	–
Real Time Axis Information		
Attribute 1	Position Feedback	–

(1) Requires custom database file contact Application Engineering at 631.444.6600.



4. Click OK.

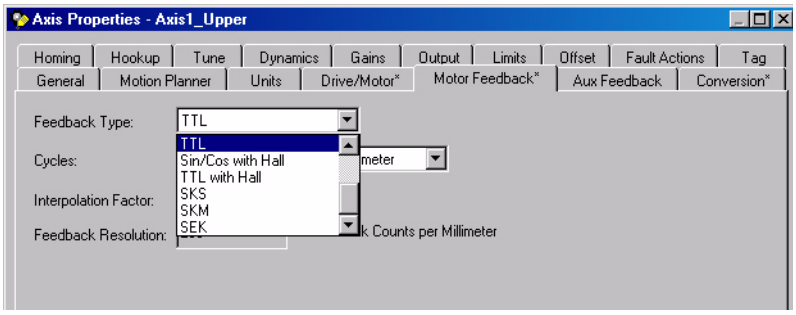
5. Click the Motor Feedback tab.

6. Using the screen image as a reference, configure the parameters as shown in the Setting column.

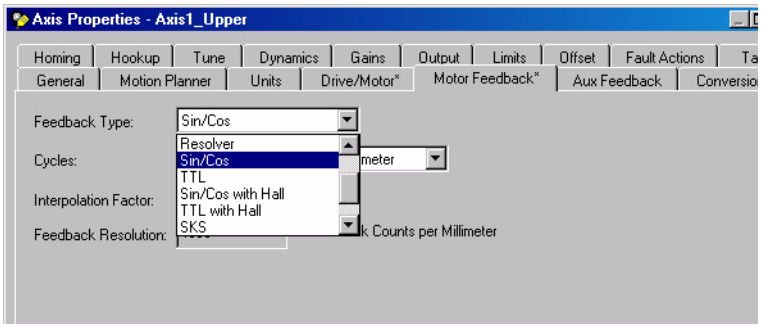
Parameter	Setting	Comment
Feedback Type	TTL or Sin/Cos	For RSLogix 5000 software,V16
	TTL with Hall or Sin/Cos with Hall	For RSLogix 5000 software, V17
Cycles	50	5 µm encoder
	125	2 µm encoder
	250	1 µm encoder
	500	0.5 µm encoder
	50	20 µm Sin/Cos encoder(1)
	25	40 µm Sin/Cos encoder
per	Millimeters	–
Interpolation Factor	4	TTL
	1024	Sin/Cos

(1) Requires custom database file contact Application Engineering at 631.444.6600.

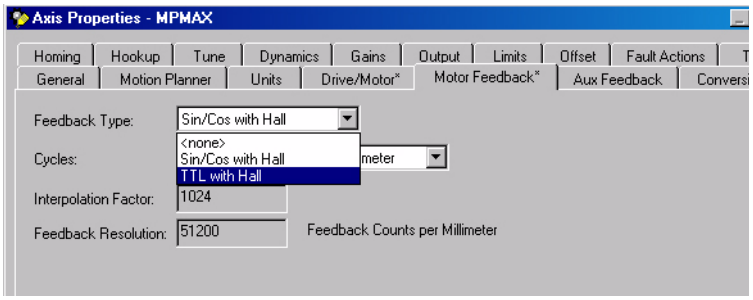
RSLogix 5000 Software Version 15.00 and 16.00 TTL Encoder



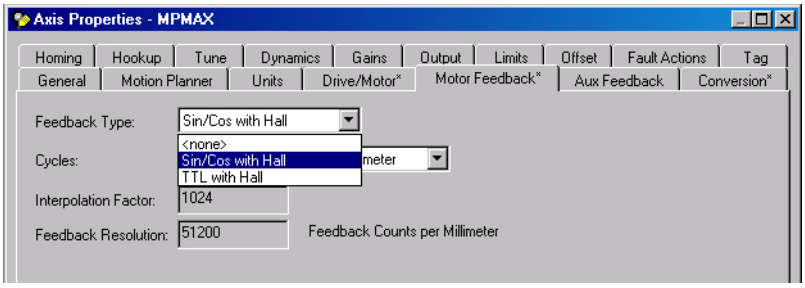
RSLogix 5000 Software Version 15.00 and 16.00 Sin/Cos Encoder



RSLogix 5000 Software Version 17.00 TTL Encoder



RSLogix 5000 Software Version 17.00 Sin/Cos Encoder



7. Click OK to set the values.

8. Click the Units tab.

9. Using the screen image as a reference, configure the parameters as shown in the Setting column.

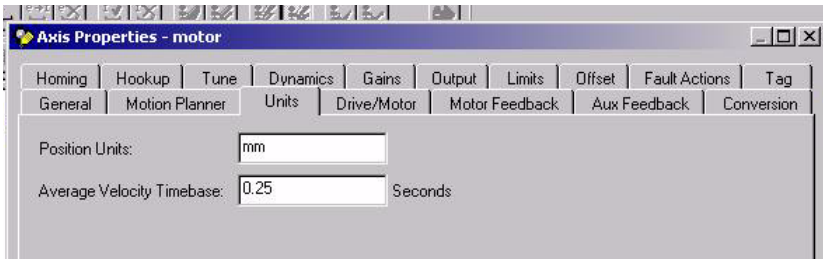
Parameter	Setting
Position Units	mm
Average Velocity Timebase	0.25 s

You can change position units to inches, or other units, on this tab.

Example for a 5 µm resolution encoder:

200 drive cnts/mm x 25.4 mm/in.
Conversion Constant = 5080 drive cnts/in.

10. Click OK to set the values.



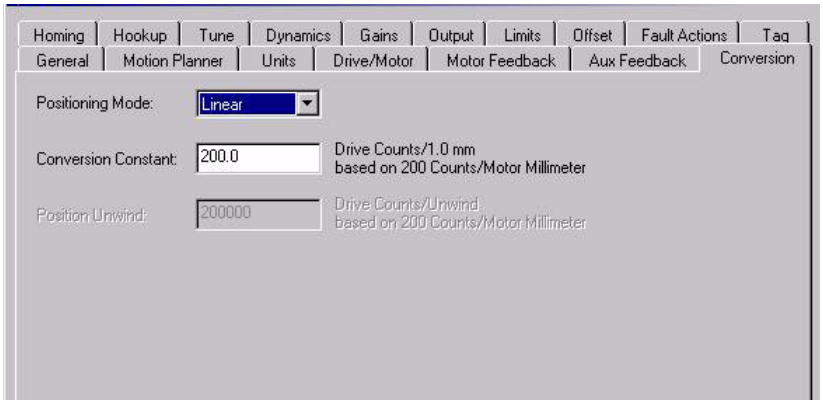
11. Click the Conversion tab.

12. Using the screen image as a reference, configure the parameters as shown in the Setting column.

Parameter	Setting	Comment
Positioning Mode	Linear	–
Conversion Constant	200	5 µm encoder
	500	2 µm encoder
	1000	1 µm encoder
	2000	0.5 µm encoder
	51200	20 µm pitch Sin/Cos encoder(1)
	25600	40 µm pitch Sin/Cos encoder

(1) Requires custom database file contact Application Engineering at 631.444.6600.

13. Click OK.



Set Up the Connection to an Ultra3000 Drive

This procedure configures the Ultra3000 drive for your linear motor and encoder combination.

For help using Ultraware software as it applies to setting up your linear motor, refer to Additional Resources on page 7. This procedure assumes you are familiar with Ultraware software.

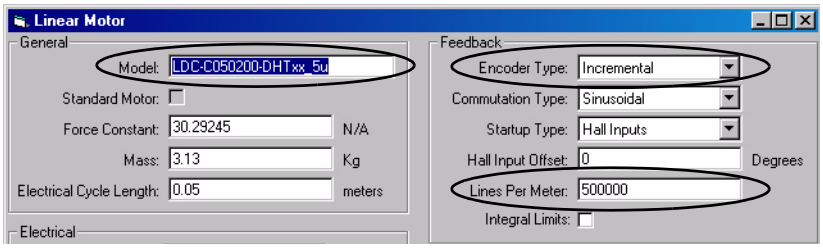
1. Open your Motor Configurator Utility.
2. Select the linear motor catalog number.
3. From the Edit menu choose Duplicate.
4. Rename Model.
5. Click Encoder Type and select either Incremental or Sin/Cos.
6. Click Lines Per Meter and the enter value.

   The following tables list typical values for lines per meter.

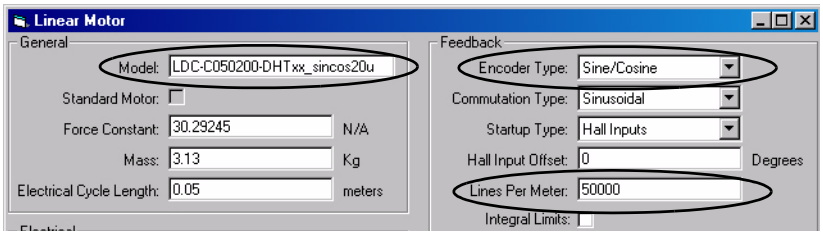
Incremental	
Resolution	**Value**
10 µm	25,000
5 µm	50,000
2 µm	125,000
1 µm	250,000
0.5 µm	500,000

Sin/Cos	
Encoder Scale Pitch	**Value**
100 µm	10,000
40 µm	25,000
20 µm	50,000

Incremental Encoder



Sin/Cos Encoder



7. Click Close.

8. Open your Ultraware software.

9. Configure for your Ultra3000 drive.

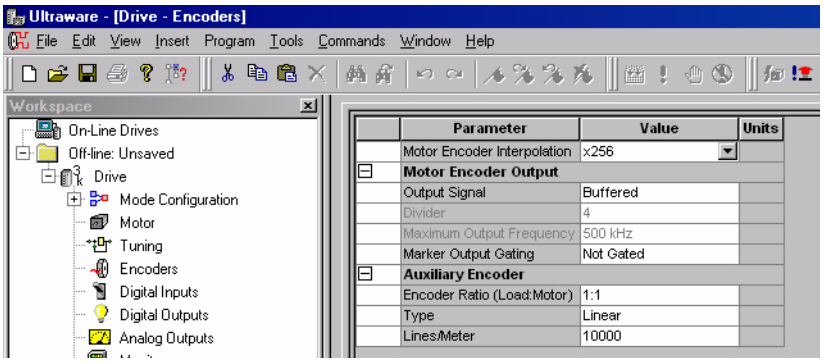
10. From Workspace select Motor.

11. Click Motor Model and choose the model you created from the pull-down menu.

    If using an incremental encoder, you are finished. For Sin/Cos encoders continue with steps12 and 13.

12. From Workspace select Encoders.

13. Click Motor Encoder Interpolation and select a value from the pull-down menu.

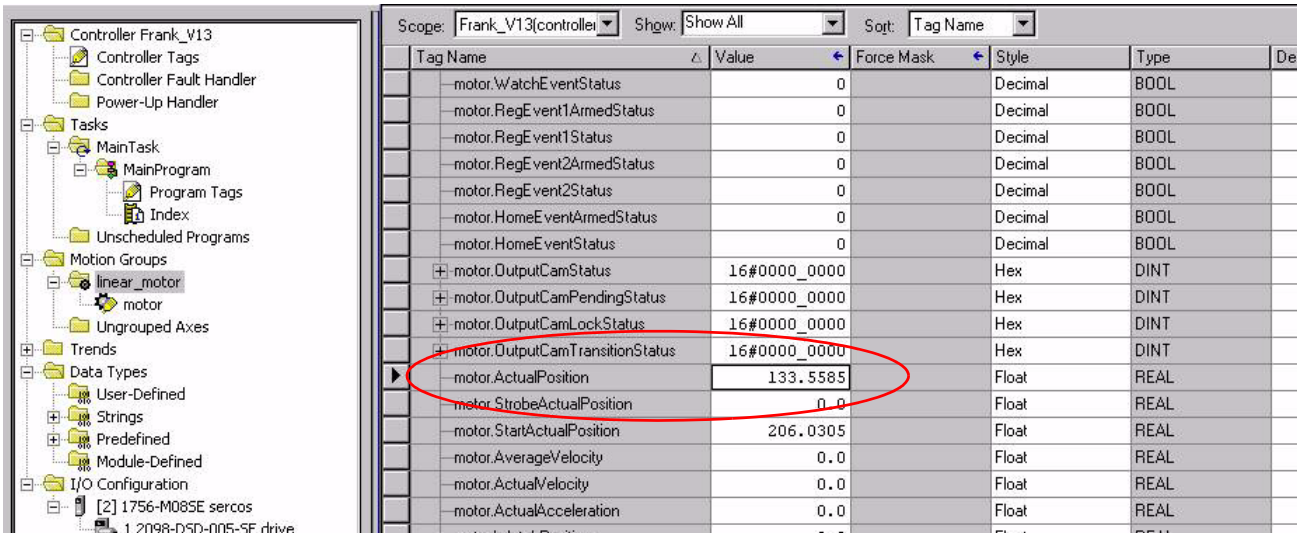


This tables shows the encoder resolutions that could be achieved when using a 20 µ Sin/Cos encoder and different interpolation values.

Value	Encoder Resolution
X4	5 µm
X8	2.5 µm
X16	1.25 µm
X32	0.625 µm
X64	0.3125 µm
X128	0.15625 µm
X256	0.078125 µm
X512	0.0390 µm
X1024	0.01953125 µm

Verify Motor Encoder Direction

In this section you select controller tag, and use the motor_ActualPostion tag to evaluate the encoder installation.



1. Disable the drive.
2. Note the ActualPostion tag value.
3. Move the axis in the positive direction.

   See page 39 for definition for positive direction.
4. Verify that the ActualPostion tag value increases as the axis moves.

   If the positive direction of travel does not match what has been defined by the motor power and Hall Sensing wiring, then change the direction by re-wiring the encoder using the following table.

Move		To	
Encoder Phase	**Drive CN2, pin**	**Encoder Phase**	**Drive CN2, pin**
A+	1	B+	3
A-	2	B-	4
B+	3	A+	1
B-	4	A-	2

Verify Motor Encoder Resolution

This test compares the physically measured distance to the distance calculated by the software. It also verifies the encoder setting in the RSLogix 5000 software.

1. Measure and mark a fixed distance of travel on the axis.
2. Record the ActualPosition tag value with carriage at the starting position.
3. Move the carriage to the end position.
4. Record the ActualPosition tag value.
5. Calculate the distance moved using the record values.
6. Compare the actual distance and the calculated distance.

   If the values do not match, verify resolution of installed encoder and the values used in the Motor Feedback, Conversion, and Units tabs.

Verify Linear Motor Wiring and Function

The Homing and Hookup tabs in RSlogix 5000 software check the motor power (U, V, W), Hall sensing signals (S1, S2, S3) and the encoder wiring are correct.

IMPORTANT The following components must be wired correctly for your drive and linear motor to operate properly:

- Hall Effect Module
- Coil Power Wires
- Thermistor
- Encoder

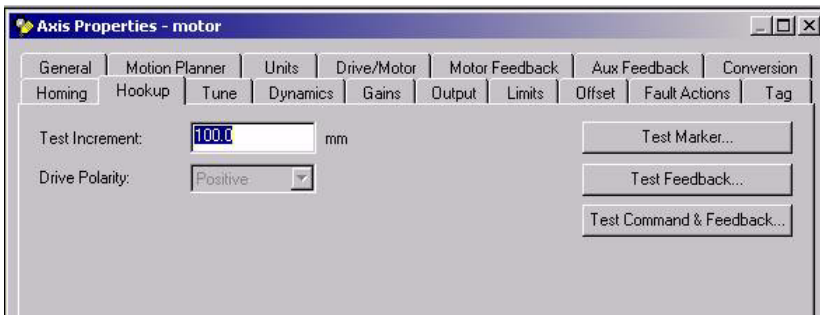
Follow this steps to verify your motor wiring and function.

1. Click the Hookup tab.
2. Configure the parameters.

   The following table shows the Suggested Settings.

Parameter	Suggested Setting
Test increment	60.00 mm
Drive Polarity	Positive

3. Click OK.



4. Click Test Marker… to run the Test Marker test.

See your encoder user documentation for location and frequency of markers.

5. Position the coil so that it can move 60 mm (2.36 in.) in the forward or reverse direction.

6. Click Test Feedback… to run the Test Feedback test.

Move the axis by hand at least 60 mm (2.36 in.) when prompted.

When using Allen-Bradley servo drives match the counting direction of your position feedback encoder to the direction the motor moves when positive current is applied.

7. Click Test Command & Feedback… to run the Test Command & Feedback test.

Follow the on-screen instructions.

IMPORTANT Be sure all the tests on the Hookup tab have passed before proceeding.

IMPORTANT When using Kinetix 6000 and Kinetix 2000 drives, the Test Command Feedback test may pass even though the Hall Effect module is not wired correctly.

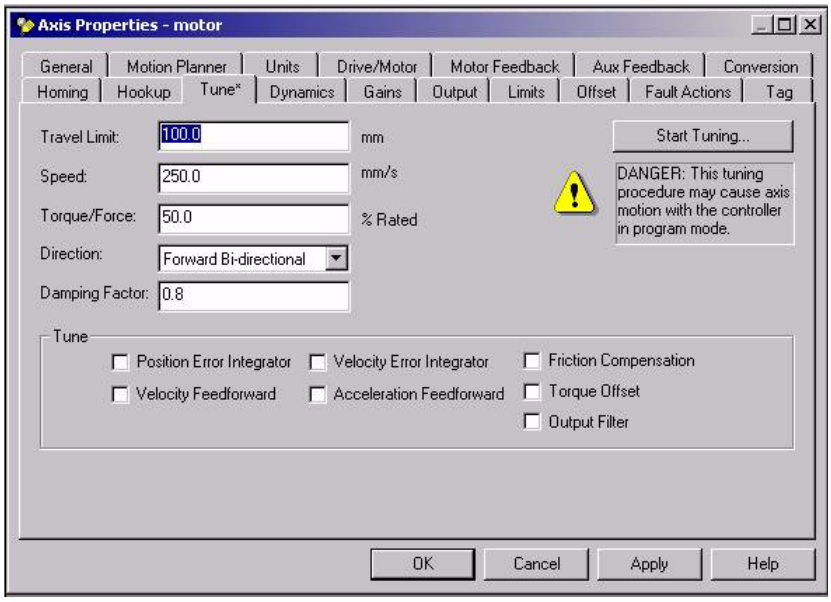
8. Click the Tune tab.

WARNING

Large Position Error Tolerances, such as those calculated by the Auto Tune function in RSLogix 5000 programming software, or when configuring a new axis with RSLogix 5000 software, can lead to undetected and repetitive high energy impacts against axis end stops if proper precautions are not in place. These tolerances can also lead to undetected and repetitive high energy impacts against unexpected obstructions. Such impacts can lead to equipment damage and/or serious injury.

To identify the safety concerns that you have with default Position Error Tolerance or after an Auto-Tune Function, go to the Rockwell Automation Knowlegebase. Click Find Technical Support Answers and search for Answer Id 55937.

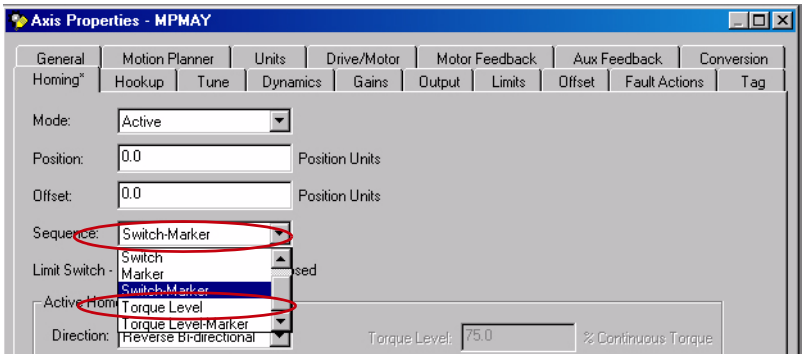
9. Configure the parameters in the Tune tab as suggested in the Initial Setting column. Leave all other tune options off for your first pass. If necessary, reduce the Velocity Loop Proportional Gain to maintain stability.



Parameter	Initial Setting	Units	Note
Travel Limit	100	mm	Suggested
Speed	250	mm/sec	–
Torque/Force	50	% Rated	–
Direction	Forward Bi-directional	–	–
Damping Factor	0.8	–	(default)

10. Click the Homing tab.

11. Choose Sequence to Switch-Marker, or Torque Level-Marker when a repeatable power-up position is desired.



Typical linear TTL and Sin/Cos encoders will home repeatability to within one count of resolution when their index mark is used.

Notes:

Specifications and Dimensions

Introduction

This appendix provides product specifications and mounting dimensions for your LDL-Series ironless linear motor components.

Performance Specifications

These tables provide performance specifications for the LDL-Series ironless linear servo motors.

Common Performance Specifications

These performance specifications apply to all LDL-Series ironless linear servo motors.

Attribute	Value
Motor type	3 phase, wye winding, synchronous permanent magnet stator, non-ventilated linear motor
Operating speed, max	10 m/s (32.8 ft/s)
Operating voltage, (not for direct connection to AC line)	230V AC rms
Dielectric rating of motor power connections (U,V,W), to ground for 1.0 s (1)	1500V AC rms, 50/60 Hz
Cogging torque	Zero
Applied bus voltage, max (2)	325V DC
Electrical cycle length	60 mm (2.36 in.)
Coil temperature, max	130 °C (266 °F)
Insulation class	130 °C (266 °F) Class B
Thermal time constant, Ref, winding to ambient	35 min
Paint color	Black

(1) Tested during manufacturing process, Do not re-apply test voltage. Contact Application Engineering (631.344.6600) for advice on testing coils post production.

(2) Maximum cable length is 10 m (32.8 ft). Contact Application Engineering (631.344.6600) for applications requiring longer cables.

LDL-Series Ironless Linear Motor Performance Specifications

LDL-Series Ironless Linear Motor (Standard 30 mm frame size)

Attribute	Units	Symbol	LDL-N030120-D*x*T*xx*	LDL-N030240-D*x*T*xx*	LDL-N030240-E*x*T*xx*
Force, continuous (1) (2) (3) (4)	N (lbf)	F_c	63 (14)	126 (28)	
Force, peak (5)	N (lbf)	F_p	209 (47)	417 (94)	
Thermal resistance	°C/W	R_{th}	1.73	0.86	
Force constant (6) (7) (8)	N/A_{pk} (lbf/A_{pk})	K_f	21.0 (4.7)	21.0 (4.7)	42.0 (9.4)
Back EMF constant p-p (6) (7) (8)	V_p/m/s (V_p/in/s)	K_e	24.8 (0.6)	24.8 (0.6)	49.6 (1.3)
Current, peak (5) (7)	A_{pk} (A_{rms})	I_p	9.9 (7.0)	19.9 (14.0)	9.9 (7.0)
Current, continuous (1) (2) (3) (4)	A_{pk} (A_{rms})	I_c	3.0 (2.1)	6.0 (4.2)	3.0 (2.1)
Resistance p-p @ 20 °C (68 °F) (6) (8)	Ohms	R_{20}	5.41	2.70	10.82
Inductance p-p (6) (8)	mH	L	8.43	4.22	16.86
Magnetic attraction	N (lbf)	F_a	0 (0)		

LDL-Series Ironless Linear Motor (Thick 30 mm frame size)

Attribute	Units	Symbol	LDL-T030120-D*x*T*xx*	LDL-T030240-D*x*T*xx*	LDL-T030240-E*x*T*xx*
Force, continuous (1) (2) (3) (4)	N (lbf)	F_c	72 (16)	144 (32)	
Force, peak (5)	N (lbf)	F_p	239 (54)	479 (108)	
Thermal resistance	°C/W	R_{th}	1.31	0.65	
Force constant (6) (7) (8)	N/A_{pk} (lbf/A_{pk})	K_f	24.1 (5.4)	24.1 (5.4)	48.2 (10.8)
Back EMF constant p-p (6) (7) (8)	V_p/m/s (V_p/in/s)	K_e	28.5 (0.7)	28.5 (0.7)	56.9 (1.4)
Current, peak (5) (7)	A_{pk} (A_{rms})	I_p	9.9 (7.0)	19.9 (14.0)	9.9 (7.0)
Current, continuous (1) (2) (3) (4)	A_{pk} (A_{rms})	I_c	3.0 (2.1)	6.0 (4.2)	3.0 (2.1)
Resistance p-p @ 20 °C (68 °F) (6) (8)	Ohms	R_{20}	7.15	3.57	14.29
Inductance p-p (6) (8)	mH	L	13.40	6.70	26.80
Magnetic attraction	N (lbf)	F_a	0 (0)		

(1) Coils at maximum temperature, 130 °C (266 °F), mounted to an aluminium heat sink whose area is noted in table on page 62, and at 40 °C (104 °F) ambient.
(2) Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
(3) For standstill conditions, multiply continuous force and continuous current by 0.9.
(4) Coil mountings on either of the two narrow sides reduces continuous force by 10%.
(5) Calculated at 11% duty cycle for 1.0 second max. Some applications may produce significantly higher peak forces. Call Applications Engineering (631.344.6600) for details.
(6) Winding parameters listed are measured line-to-line (phase-to-phase).
(7) Currents and voltages listed are measured 0-peak of the sine wave unless noted as rms.
(8) Specifications are ±10%. Phase-to-phase inductance is ±30%.

LDL-Series Ironless Linear Motor (Standard 50 mm frame size)

Attribute	Units	Symbol	LDL-N050120-D*xTxx*	LDL-N050240-D*xTxx*	LDL-N050240-E*xTxx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	96 (22)	191 (43)	
Force, peak [5]	N (lbf)	F_p	317 (71)	635 (143)	
Thermal resistance	°C/W	R_{th}	1.58	0.79	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	35.0 (7.9)	35.0 (7.9)	70.0 (15.7)
Back EMF constant p-p [6] [7] [8]	V_p/m/s (V_p/in/s)	K_e	41.3 (1.1)	41.3 (1.1)	82.7 (2.1)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	9.1 (6.4)	18.1 (12.8)	9.1 (6.4)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	2.7 (1.9)	5.5 (3.9)	2.7 (1.9)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	7.11	3.56	14.22
Inductance p-p [6] [8]	mH	L	11.08	5.54	22.16
Magnetic attraction	N (lbf)	F_a	0 (0)		

Attribute	Units	Symbol	LDL-N050360-D*xTxx*	LDL-N050360-E*xTxx*	LDL-N050480-D*xTxx*	LDL-N050480-E*xTxx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	287 (65)		383 (86)	
Force, peak [5]	N (lbf)	F_p	952 (214)		1269 (285)	
Thermal resistance	°C/W	R_{th}	0.53		0.39	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	35.0 (7.9)	105.0 (23.6)	35.0 (7.9)	70.0 (15.7)
Back EMF constant p-p [6] [7] [8]	V_p/m/s (V_p/in/s)	K_e	41.3 (1.1)	124.0 (3.2)	41.3 (1.1)	82.7 (2.1)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	27.2 (19.2)	9.1 (6.4)	36.3 (25.6)	18.1 (12.8)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	8.2 (5.8)	2.7 (1.9)	10.9 (7.7)	5.5 (3.9)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	2.37	21.33	1.78	7.11
Inductance p-p [6] [8]	mH	L	3.69	33.25	2.77	11.08
Magnetic attraction	N (lbf)	F_a	0 (0)			

(1) Coils at maximum temperature, 130 °C (266 °F), mounted to an aluminium heat sink whose area is noted in table on page 62, and at 40 °C (104 °F) ambient.
(2) Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
(3) For standstill conditions, multiply continuous force and continuous current by 0.9.
(4) Coil mountings on either of the two narrow sides reduces continuous force by 10%.
(5) Calculated at 11% duty cycle for 1.0 second max. Some applications may produce significantly higher peak forces. Call Applications Engineering (631.344.6600) for details.
(6) Winding parameters listed are measured line-to-line (phase-to-phase).
(7) Currents and voltages listed are measured 0-peak of the sine wave unless noted as rms.
(8) Specifications are ±10%. Phase-to-phase inductance is ±30%.

LDL-Series Ironless Linear Motor (Thick 50 mm frame size)

Attribute	Units	Symbol	LDL-T050120-D*x*T*xx*	LDL-T050240-D*x*T*xx*	LDL-T050240-E*x*T*xx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	110 (25)	220 (49)	
Force, peak [5]	N (lbf)	F_p	364 (82)	728 (164)	
Thermal resistance	°C/W	R_{th}	1.19	0.60	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	40.2 (9.0)	40.2 (9.0)	80.4 (18.1)
Back EMF constant p-p [6] [7] [8]	V_p/m/s (V_p/in/s)	K_e	47.4 (1.2)	47.4 (1.2)	94.9 (2.4)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	9.1 (6.4)	18.1 (12.8)	9.1 (6.4)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	2.7 (1.9)	5.5 (3.9)	2.7 (1.9)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	9.42	4.71	18.83
Inductance p-p [6] [8]	mH	L	18	9	35.31
Magnetic attraction	N (lbf)	F_a	0 (0)		

Attribute	Units	Symbol	LDL-T050360-D*x*T*xx*	LDL-T050360-E*x*T*xx*	LDL-T050480-D*x*T*xx*	LDL-T050480-E*x*T*xx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	329 (74)		439 (99)	
Force, peak [5]	N (lbf)	F_p	1093 (246)		1457 (327)	
Thermal resistance	°C/W	R_{th}	0.40		0.30	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	40.2 (9.0)	120.5 (27.1)	40.2 (9.0)	80.4 (18.1)
Back EMF constant p-p [6] [7] [8]	V_p/m/s (V_p/in/s)	K_e	47.4 (1.2)	142.3 (3.6)	47.4 (1.2)	94.9 (2.4)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	27.2 (19.2)	9.1 (6.4)	36.3 (25.6)	18.1 (12.8)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	8.2 (5.8)	2.7 (1.9)	10.9 (7.7)	5.5 (3.9)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	3.14	28.25	2.35	9.42
Inductance p-p [6] [8]	mH	L	5.88	52.96	4.41	17.65
Magnetic attraction	N (lbf)	F_a	0 (0)			

(1) Coils at maximum temperature, 130 °C (266 °F), mounted to an aluminium heat sink whose area is noted in table on page 62, and at 40 °C (104 °F) ambient.
(2) Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
(3) For standstill conditions, multiply continuous force and continuous current by 0.9.
(4) Coil mountings on either of the two narrow sides reduces continuous force by 10%.
(5) Calculated at 11% duty cycle for 1.0 second max. Some applications may produce significantly higher peak forces. Call Applications Engineering (631.344.6600) for details.
(6) Winding parameters listed are measured line-to-line (phase-to-phase).
(7) Currents and voltages listed are measured 0-peak of the sine wave unless noted as rms.
(8) Specifications are ±10%. Phase-to-phase inductance is ±30%.

LDL-Series Ironless Linear Motor (Standard 75 mm frame size)

Attribute	Units	Symbol	LDL-N075480-D*xTxx*	LDL-N075480-E*xTxx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	519 (117)	
Force, peak [5]	N (lbf)	F_p	1723 (387)	
Thermal resistance	°C/W	R_{th}	0.37	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	52.5 (11.8)	105.0 (23.6)
Back EMF constant p-p [6] [7] [8]	$V_p/m/s$ ($V_p/in/s$)	K_e	62.0 (1.6)	124.0 (3.2)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	32.8 (23.2)	16.4 (11.6)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	9.9 (7.0)	4.9 (3.5)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	2.31	9.24
Inductance p-p [6] [8]	mH	L	3.60	14.40
Magnetic attraction	N (lbf)	F_a	0 (0)	

LDL-Series Ironless Linear Motor (Thick 75 mm frame size)

Attribute	Units	Symbol	LDL-T075480-D*xTxx*	LDL-T075480-E*xTxx*
Force, continuous [1] [2] [3] [4]	N (lbf)	F_c	596 (134)	
Force, peak [5]	N (lbf)	F_p	1977 (444)	
Thermal resistance	°C/W	R_{th}	0.28	
Force constant [6] [7] [8]	N/A_{pk} (lbf/A_{pk})	K_f	60.3 (13.5)	120.5 (27.1)
Back EMF constant p-p [6] [7] [8]	$V_p/m/s$ ($V_p/in/s$)	K_e	71.2 (1.8)	142.3 (3.6)
Current, peak [5] [7]	A_{pk} (A_{rms})	I_p	32.8 (23.2)	16.4 (11.6)
Current, continuous [1] [2] [3] [4]	A_{pk} (A_{rms})	I_c	9.9 (7.0)	4.9 (3.5)
Resistance p-p @ 20 °C (68 °F) [6] [8]	Ohms	R_{20}	3.06	12.25
Inductance p-p [6] [8]	mH	L	5.74	22.97
Magnetic attraction	N (lbf)	F_a	0 (0)	

(1) Coils at maximum temperature, 130 °C (266 °F), mounted to an aluminium heat sink whose area is noted in table on page 62, and at 40 °C (104 °F) ambient.
(2) Continuous force and current based on coil moving with all phases sharing the same load in sinusoidal commutation.
(3) For standstill conditions, multiply continuous force and continuous current by 0.9.
(4) Coil mountings on either of the two narrow sides reduces continuous force by 10%.
(5) Calculated at 11% duty cycle for 1.0 second max. Some applications may produce significantly higher peak forces. Call Applications Engineering (631.344.6600) for details.
(6) Winding parameters listed are measured line-to-line (phase-to-phase).
(7) Currents and voltages listed are measured 0-peak of the sine wave unless noted as rms.
(8) Specifications are ±10%. Phase-to-phase inductance is ±30%.

General Specifications

These tables provide weight, heat sink, environmental for LDL-Series ironless linear motors.

Weight Specifications

Weight Specifications - Motor Coil with Flying Leads

Cat. No.	Weight, Approx. kg (lb)	Cat. No.	Weight, Approx. kg (lb)
LDL-N030120-DHT20	0.63 (1.38)	LDL-T050240-*x*HT20	1.71 (3.77)
LDL-T030120-DHT20	0.74 (1.64)	LDL-N050360-*x*HT20	2.03 (4.47)
LDL-N030240-*x*HT20	1.14 (2.51)	LDL-T050360-*x*HT20	2.50 (5.52)
LDL-T030240-*x*HT20	1.37 (3.02)	LDL-N050480-*x*HT20	2.67 (5.88)
LDL-N050120-DHT20	0.75 (1.66)	LDL-T050480-*x*HT20	3.30 (7.28)
LDL-T050120-DHT20	0.91 (2.01)	LDL-N075480-*x*HT20	3.32 (7.32)
LDL-N050240-*x*HT20	1.39 (3.07)	LDL-T075480-*x*HT20	4.16 (9.18)

Weight Specifications - Motor Coil with Connectors

Cat. No.	Weight, Approx. kg (lb)	Cat. No.	Weight, Approx. kg (lb)
LDL-N030120-DHT11	0.83 (1.83)	LDL-T050240-*x*HT11	1.91 (4.21)
LDL-T030120-DHT11	0.94 (2.07)	LDL-N050360-*x*HT11	2.23 (4.92)
LDL-N030240-*x*HT11	1.34 (2.95)	LDL-T050360-*x*HT11	2.70 (5.95)
LDL-T030240-*x*HT11	1.57 (3.46)	LDL-N050480-*x*HT11	3.50 (7.72)
LDL-N050120-DHT11	0.95 (2.09)	LDL-T050480-*x*HT11	4.36 (9.61)
LDL-T050120-DHT11	1.01 (2.22)	LDL-N075480-*x*HT11	3.52 (7.76)
LDL-N050240-*x*HT11	1.41 (3.11)	LDL-T075480-*x*HT11	4.36 (9.61)

Weight Specifications - Motor Magnet Channel

Cat. No.	Weight, Approx. kg (lb)	Cat. No.	Weight, Approx. kg (lb)
LDL-NM030120	1.37 (3.02)	LDL-TM050120	1.89 (4.17)
LDL-NM030480	5.51 (12.15)	LDL-TM050480	7.57 (16.69)
LDL-TM030120	1.40 (3.08)	LDL-NM075120	2.91 (6.42)
LDL-TM030480	5.60 (12.35)	LDL-NM075480	11.64 (25.66)
LDL-NM050120	1.87 (4.12)	LDL-TM075120	2.94 (6.48)
LDL-NM050480	7.48 (116.49)	LDL-TM075480	11.76 (25.93)

Carriage Weight and Heat Sink Area Requirements

Cat. No.	Required Heat Sink Area cm^2 ($in.^2$)	Required Carriage Plate Weight kg (lb)
LDL-*x*030120-DHT*xx*	774 (120)	1.4 (3)
LDL-*x*030240-*x*HT*xx*	1160 (180)	2.0 (4.5)
LDL-*x*050120-DHT*xx*	774 (120)	2.7 (6)
LDL-*x*050240-DHT*xx*	1160 (180)	4.0 (9)
LDL-*x*050360-DHT*xx*	1680 (260)	5.9 (13)
LDL-*x*050480-DHT*xx*	2060 (320)	7.3 (16)
LDL-*x*075480-*x*HT*xx*	2060 (320)	7.3 (16)

Environmental Specifications

Attribute	Value
Temperature, operating ambient	0…40 °C (32…104 °F)
Temperature, storage ambient	-30…70 °C (-22…158 °F)
Humidity, relative non-condensing	5…95%
Liquid/dust protection	IP 65
Shock, max.	20 g peak, 6 ms duration
Vibration, max	30…2000 Hz, 2.5 g peak

Certifications

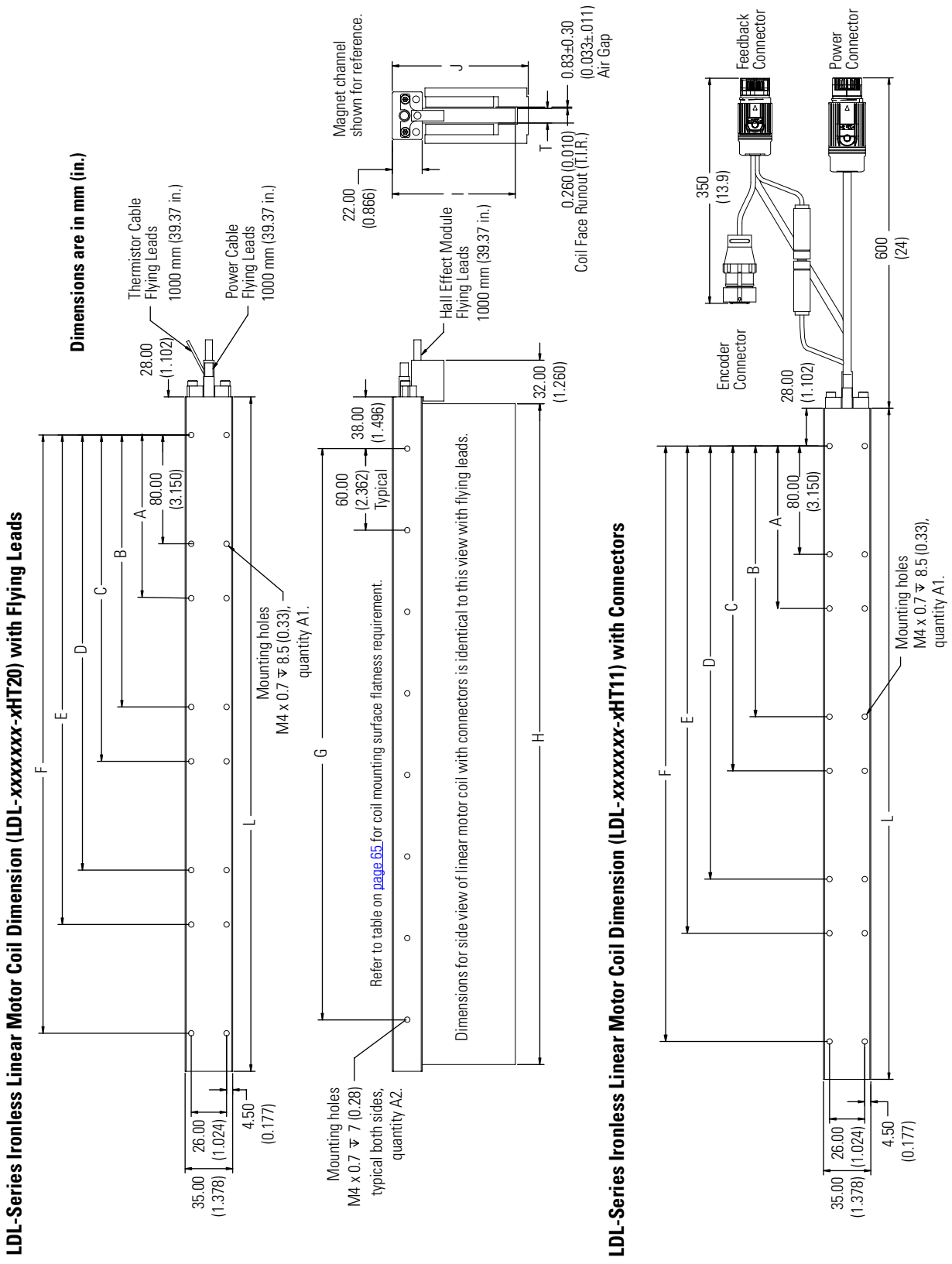
Certification[1] (when product is marked)	Standards
c-UL-us	UL recognized to U.S. and Canadian safety standards (UL 1004-1 and 840 File E230241).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with: • EN 60034-1:2004 Rotating Electrical Machines, Part I: Rating and Performance. • EN 60204-1:2006 Safety of Machinery – Electrical Equipment of Machines, Part 1: General Requirements.

(1) Refer to http://www.ab.com for Declarations of Conformity Certificates.

Product Dimensions

LDL-Series ironless linear motor components are designed to metric dimensions. Inch dimensions are conversions from millimeters. Untoleranced dimensions are for reference.

Motor Coil Dimensions



LDL-Series Ironless Linear Motor Coil Dimensions (LDL-*xxxx-x*HT*xx*)

Cat. No.	L mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)	G mm (in.)	H mm (in.)	I mm (in.)	J (1) mm (in.)	T mm (in.)	A1 Qty	A2 Qty	Power Cable Gauge mm^2 (AWG)	Flatness mm/300 x 300 (in./12 x 12)
LDL-N030120-DHT*xx*	136.0 (5.35)	–	–	–	–	–	–	60.00 (2.362)	126.00 (4.961)	70.50 (2.776)	80.00 (3.149)	8.30 (0.33)	4	2	0.50 (20)	0.25 (0.010)
LDL-T030120-DHT*xx*												10.80 (0.43)				
LDL-N030240-*x*HT*xx*	256.0 (10.08)	120.00 (4.724)	200.00 (7.874)	–	–	–	–	180.00 (7.087)	246.00 (9.685)			8.30 (0.33)	8	4		
LDL-T030240-*x*HT*xx*												10.80 (0.43)				
LDL-N050120-DHT*xx*	136.0 (5.35)	–	–	–	–	–	–	60.00 (2.362)	126.00 (4.961)	90.50 (3.563)	100.00 (3.937)	8.30 (0.33)	4	2		
LDL-T050120-DHT*xx*												10.80 (0.43)				
LDL-T050240-*x*HT*xx*	256.0 (10.08)	120.0 (4.724)	200 (7.874)	–	–	–	–	180.00 (7.087)	246.00 (9.685)			8.30 (0.33)	8	4		
LDL-N050240-*x*HT*xx*												10.80 (0.43)				
LDL-T050360-*x*HT*xx*	376.0 (14.80)	120.00 (4.724)	200 (7.874)	240.00 (9.449)	320.00 (12.598)	–	–	300.00 (11.811)	366.00 (14.409)			8.30 (0.33)	12	6		0.38 (0.015)
LDL-N050360-*x*HT*xx*												10.80 (0.43)				
LDL-N050480-DHT*xx*	496.0 (19.53)	120.00 (4.724)	200 (7.874)	240.00 (9.449)	320.00 (12.598)	360.00 (14.173)	440.00 (17.323)	420.00 (16.535)	486.00 (19.134)			8.30 (0.33)	16	8	0.75 (18)	0.64 (0.025)
LDL-N050480-EHT*xx*															0.50 (20)	
LDL-T050480-*x*HT*xx*												10.80 (0.43)			0.50 (20)	
LDL-N075480-DHT*xx*										115.50 (4.547)	130.00 (5.118)	8.30 (0.33)			0.75 (18)	
LDL-N075480-EHT*xx*															0.50 (20)	
LDL-T075480-DHT*xx*												10.80 (0.43)			0.75 (18)	
LDL-T075480-EHT*xx*															0.50 (20)	

(1) Tolerance for J dimension is ±0.26 mm (0.010 in.).

Cable Specifications

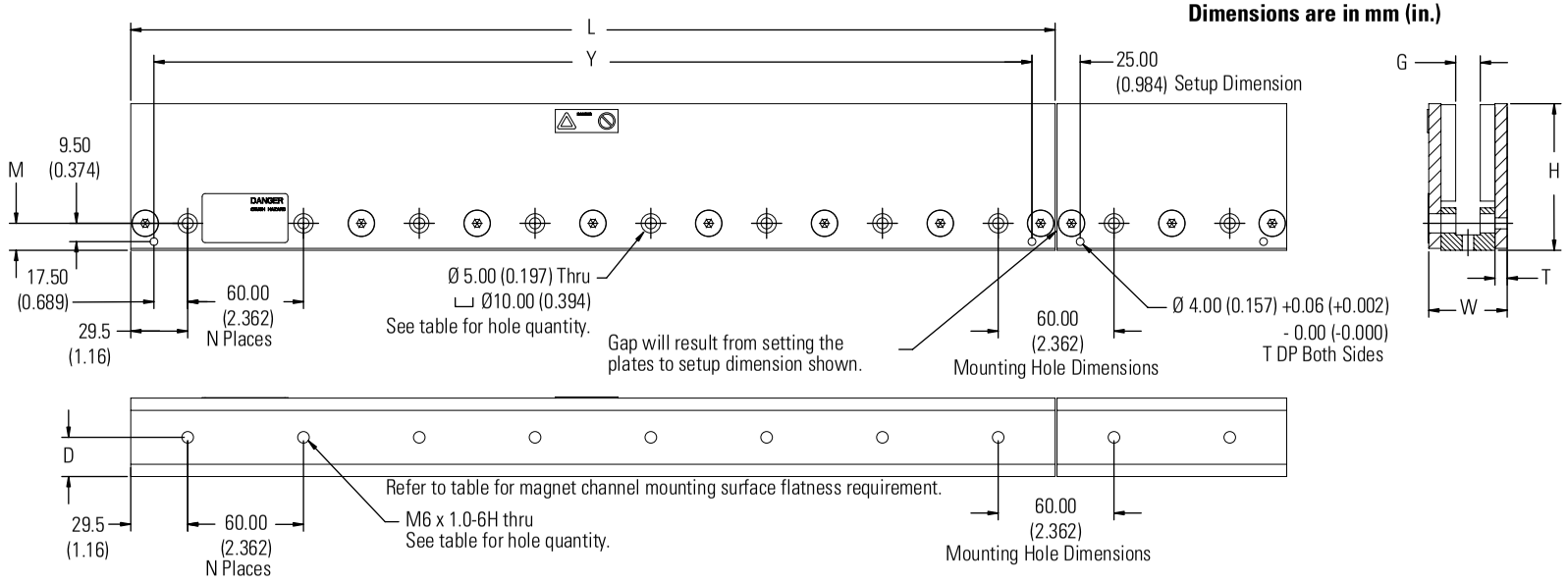
Cable (1)	Conductors	Gauge mm^2 (AWG)	Shield Type	Cable Dia. mm (in.)	Static Bend Radius mm (in.)
Power (2)	4	0.82 (18)	Braid	7.0 (0.28)	18.0 (0.70)
Power (2)	4	0.52 (20)	Braid	6.4 (0.25)	17.0 (0.67)
Thermistor	2	0.20 (26)	None	4.0 (0.16)	10.0 (0.40)
Hall Module	6	0.13 (24)	Foil	5.0 (0.20)	15.0 (0.59)

(1) All cables are non-flex.

(2) Power cable specification is dependent on coil used. See Power Cable Gauge column in the table on the top of this page.

LDL-Series Ironless Linear Motor Magnet Channel Dimensions

Dimensions are in mm (in.)



Magnet Channel Dimensions

Cat. No.	W mm (in.)	H mm (in.)	T mm (in.)	G (1) mm (in.)	D mm (in.)	L (2) mm (in.)	M mm (in.)	N	Hole Qty	Y (3) mm (in.)	Flatness mm/300 x 300 (in./12 x 12)
LDL-NM030120	37.80 (1.1488)	56.00 (2.205)	6.35 (0250)	9.86 (0.388)	18.90 (0.744)	119.00 (4.685)	14.00 (0.551)	1	2	95.00 (3.740)	0.13 (0.005)
LDL-NM030480						479.00 (18.858)		7	8	455.00 (17.913)	0.26 (0.010)
LDL-TM030120	40.65 (1.600)			12.57 (0.494)	20.33 (0.800)	119.00 (4.685)		1	2	95.00 (3.740)	0.13 (0.005)
LDL-TM030480						479.00 (18.858)		7	8	455.00 (17.913)	0.26 (0.010)
LDL-NM050120	37.80 (1.488)	76.00 (2.992)	6.35 (0.250)	9.86 (0.388)	18.90 (0.744)	119.00 (4.685)	14.00 (0.551)	1	2	95.00 (3.74)	0.13 (0.005)
LDL-NM050480						479.00 18.858)		7	8	455.00 (17.913)	0.26 (0.010)
LDL-TM050120	40.65 (1.600)			12.57 (0.494)	20.33 (0.800)	119.00 (4.685)		1	2	94.00 (3.740)	0.13 (0.005)
LDL-TM050480						479.00 (18.858)		7	8	455.00 (17.913)	0.26 (0.010)
LDL-NM075120	41.1 (1.62)	106.0 (4.173)	8.00 (0.315)	9.86 (0.388)	20.55 (0.809)	119.00 (4.685)	19.00 (0.748)	1	2	95.00 3.740)	0.13 (0.005)
LDL-NM075480						479.00 (18.858)		7	8	455.00 (17.913)	0.26 (0.010)
LDL-TM075120	43.7 (1.72)			12.57 (0.494)	21.85 (0.860)	119.00 (4.685)		1	2	95.00 (3.740)	0.13 (0.005)
LDL-TM075480						479.00 (18.858)		7	8	455.00 (17.913)	0.26 (0.010)

1) Tolerance for G dimension is +0.35 mm (+0.012 in.), -0.12 mm (-0.004 in.).
2) Tolerance for L dimension is ±0.25 mm (±0.010 in.).
3) Tolerance for Y dimension is ±0.05 mm (±0 in.002 in.).

Interconnect Diagrams

Introduction

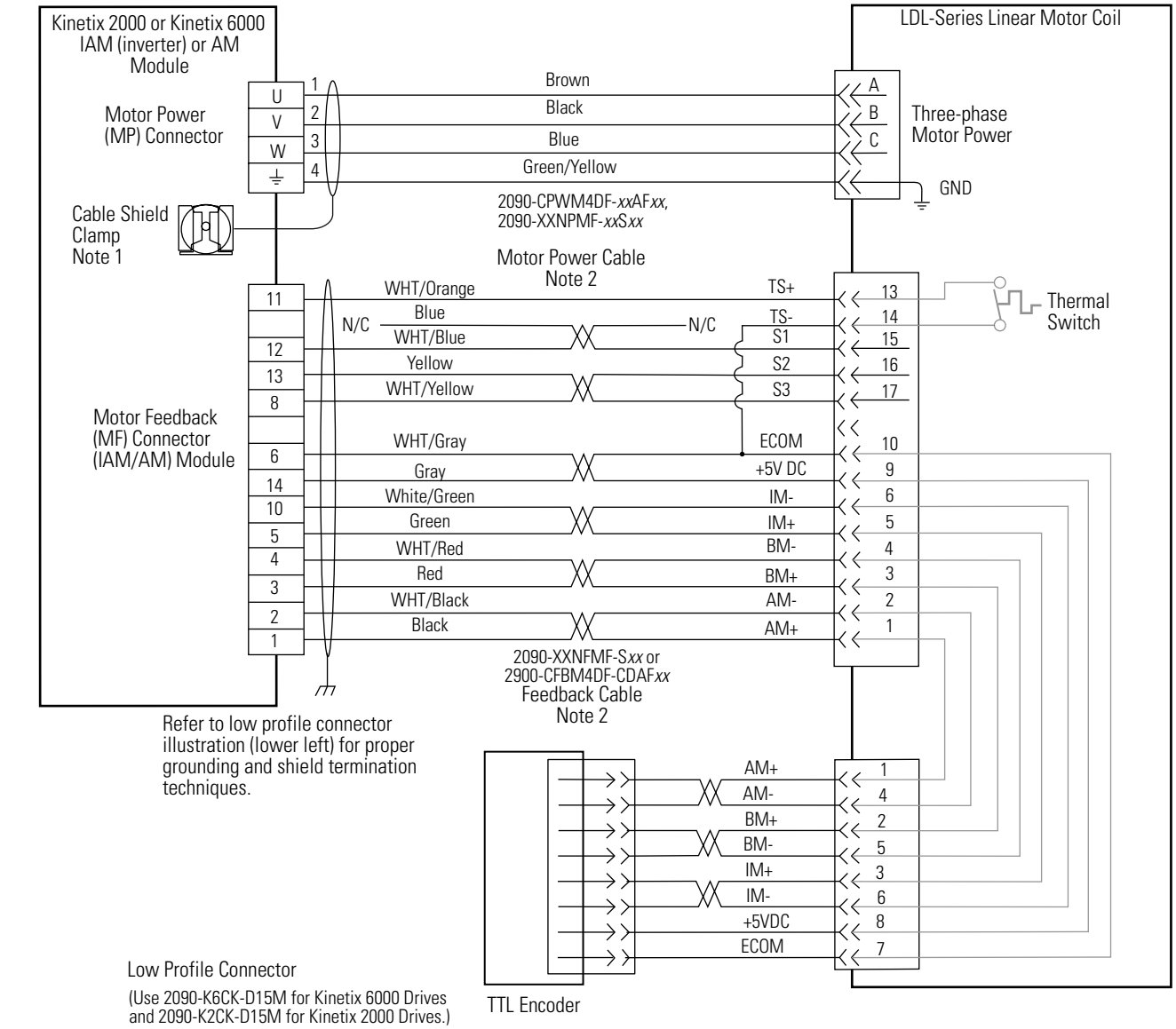
This appendix provides wring examples to assist you in wring an LDL-Series linear motors to an Allen-Bradley drive.

Wiring Examples

These notes apply to the wiring examples on the pages that follow.

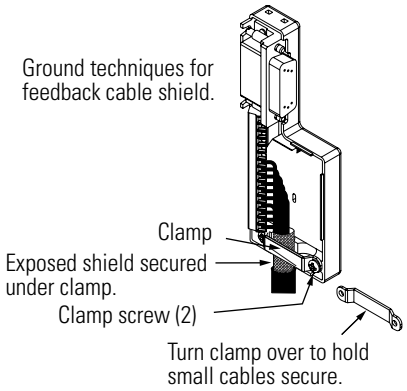
Note	Information
1	Use cable shield clamp in order to meet CE requirements. No external connection to ground is required.
2	For motor cable specifications, refer to the Kinetix Motion Control Selection Guide, publication GMC-SG001.
3	When using Sin/Cos encoder with Kinetix 6000 drives refer to Appendix C on page 77.

Wiring Example for Kinetix 6000 or Kinetix 2000 Drives and LDL-*xxxxxxx*-*x*HT11 Linear Motor with a TTL Encoder

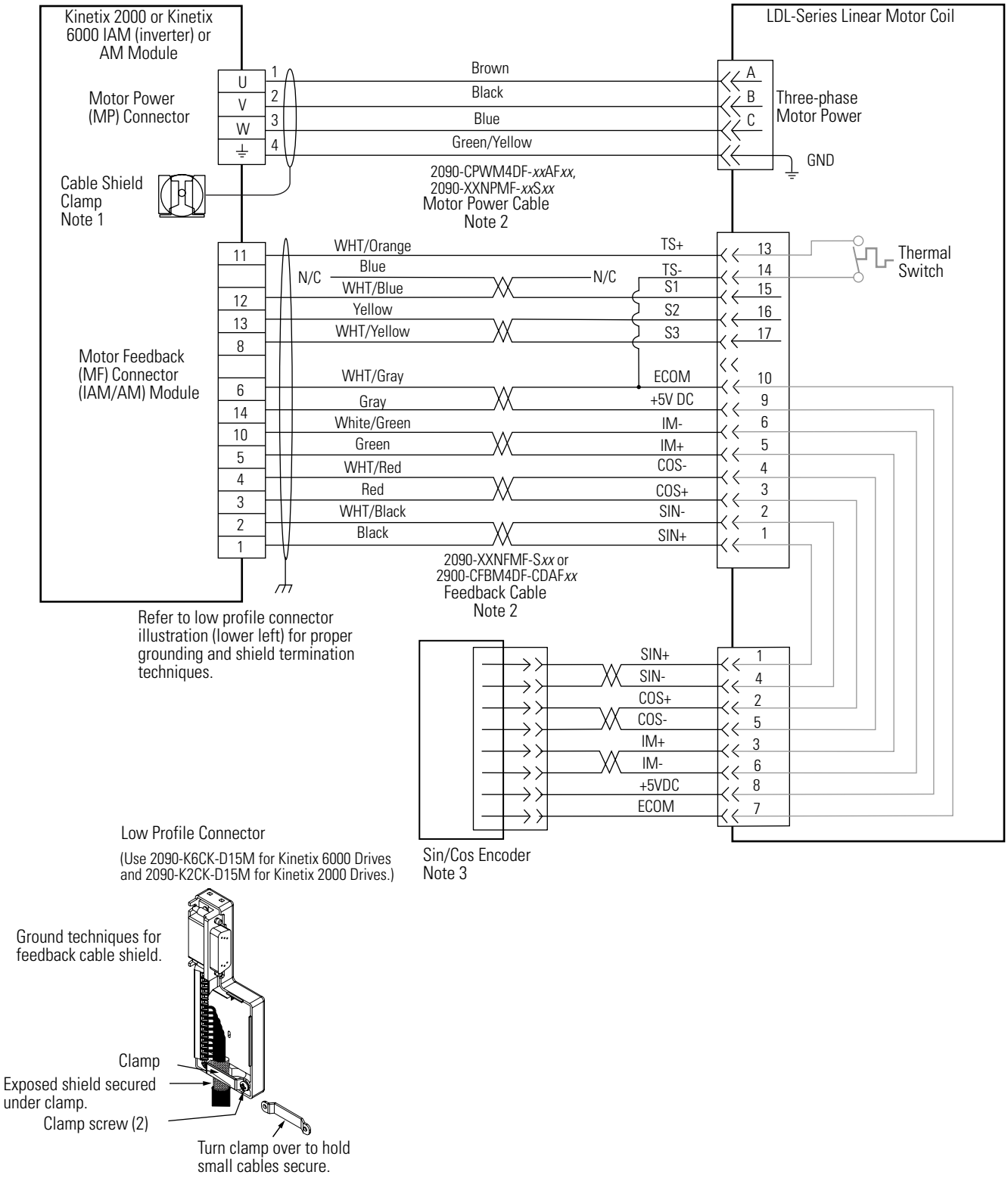


Low Profile Connector

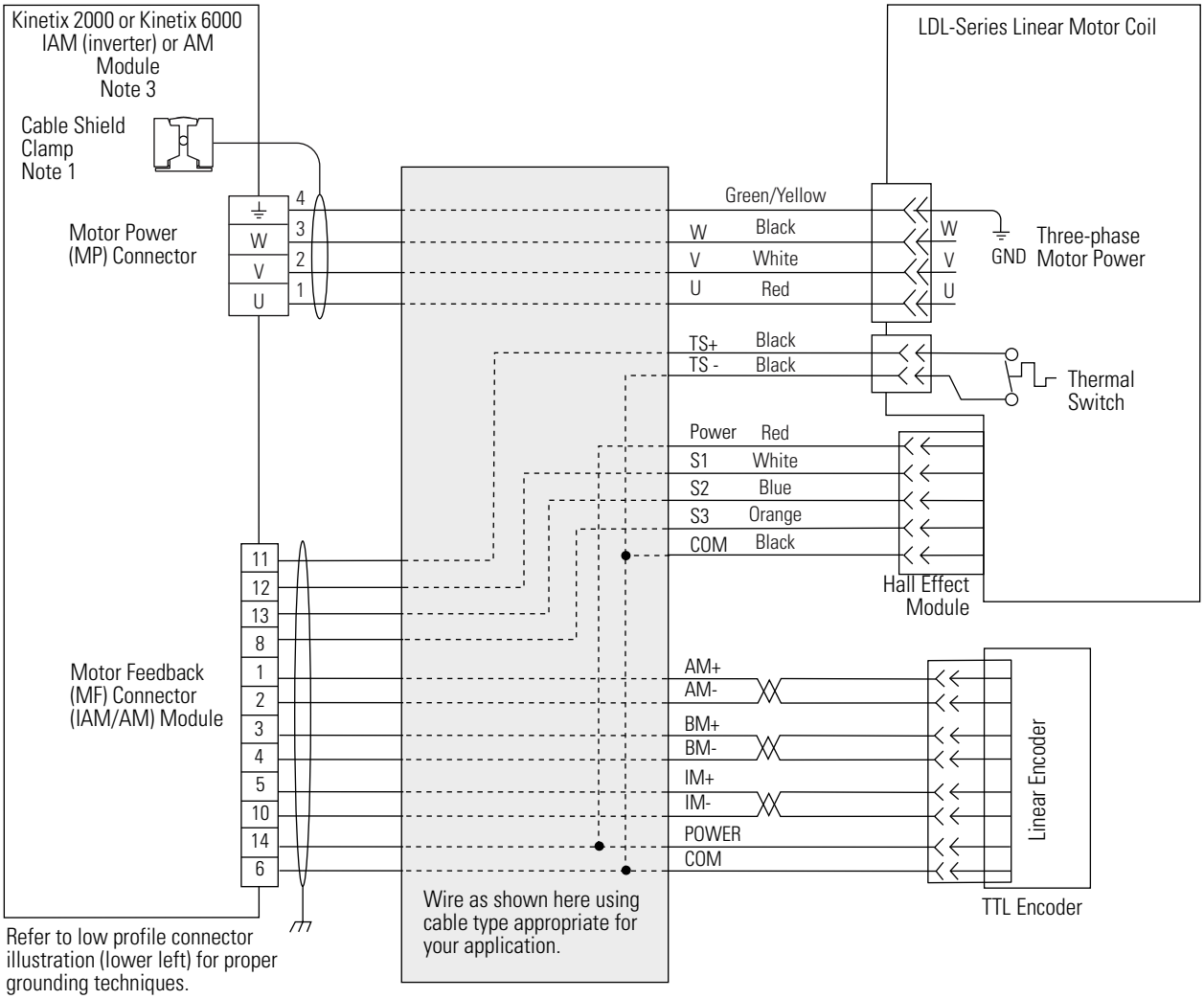
(Use 2090-K6CK-D15M for Kinetix 6000 Drives and 2090-K2CK-D15M for Kinetix 2000 Drives.)

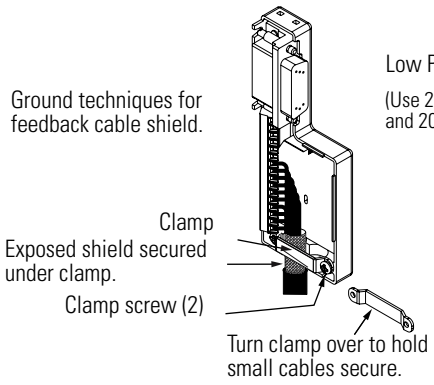


Wiring Example for Kinetix 6000 or Kinetix 2000 Drives and LDL-*xxxxxxx-x*HT11 Linear Motor with a Sin/Cos Encoder



Wiring Example for Kinetix 6000 or Kinetix 2000 Drives and LDL-*xxxxxxx*-*x*HT20 Linear Motor with a TTL Encoder

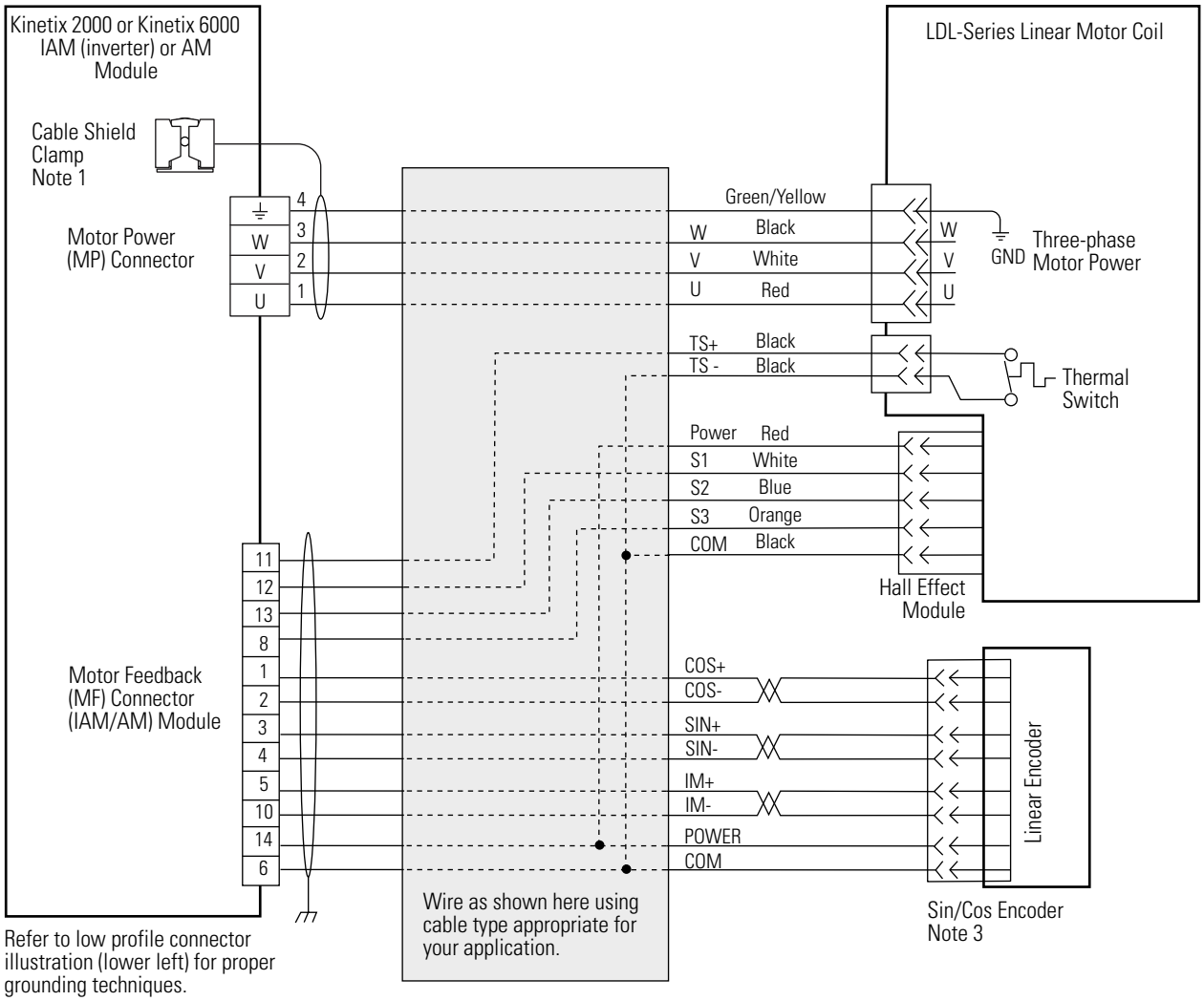


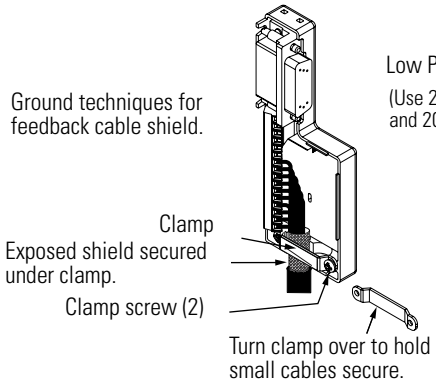


Low Profile Connector

(Use 2090-K6CK-D15M for Kinetix 6000 Drives and 2090-K2CK-D15M for Kinetix 2000 Drives.)

Wiring Example for Kinetix 6000 or Kinetix 2000 Drives and LDL-*xxxxxxx-x*HT20 Linear Motor with a Sin/Cos Encoder

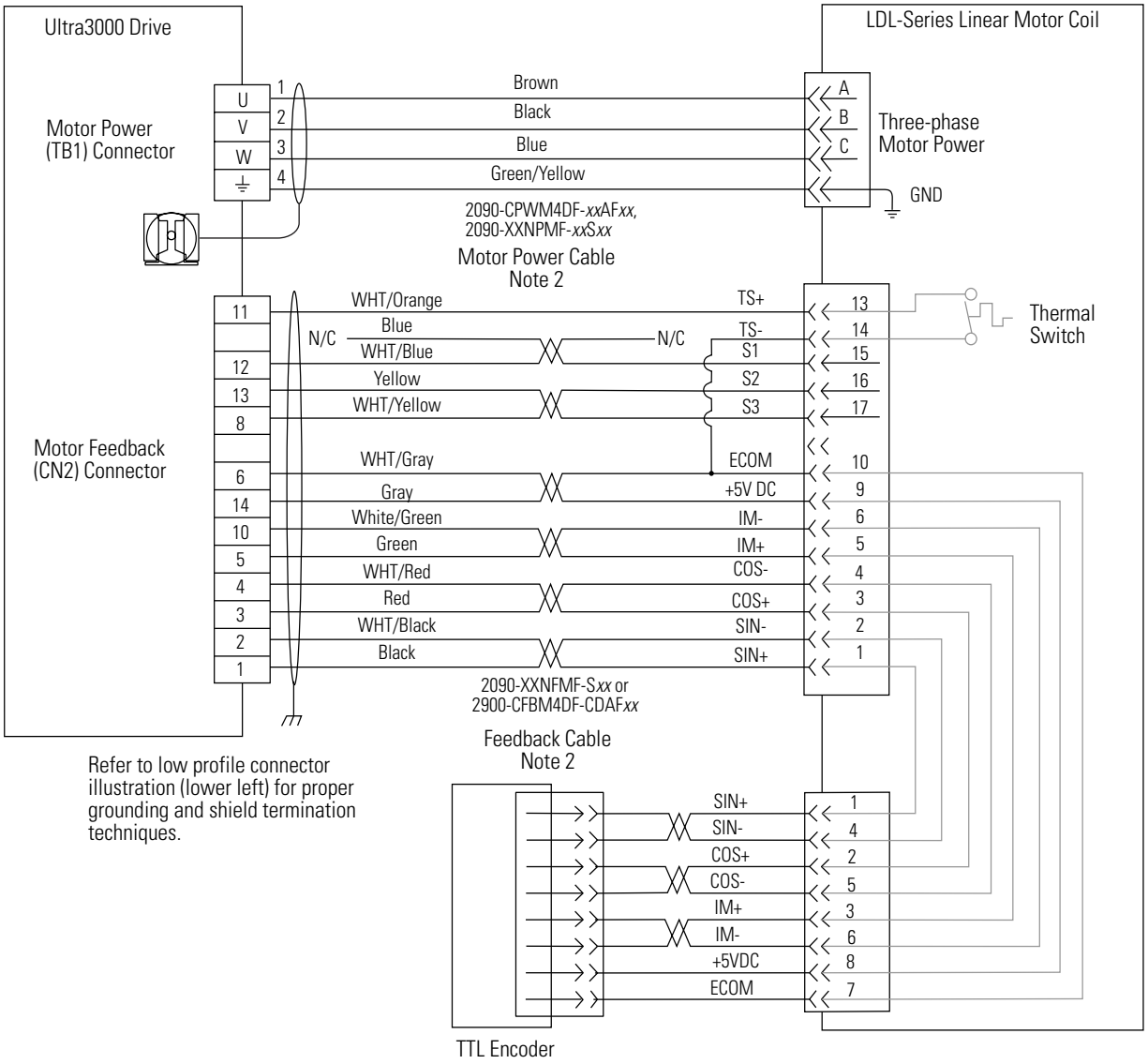


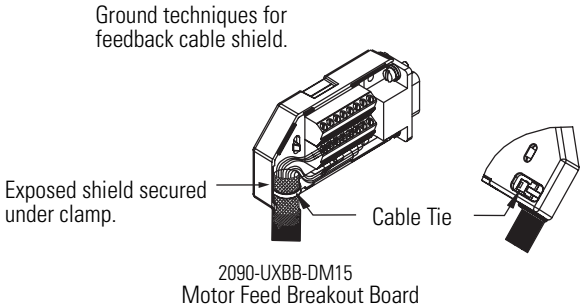


Low Profile Connector

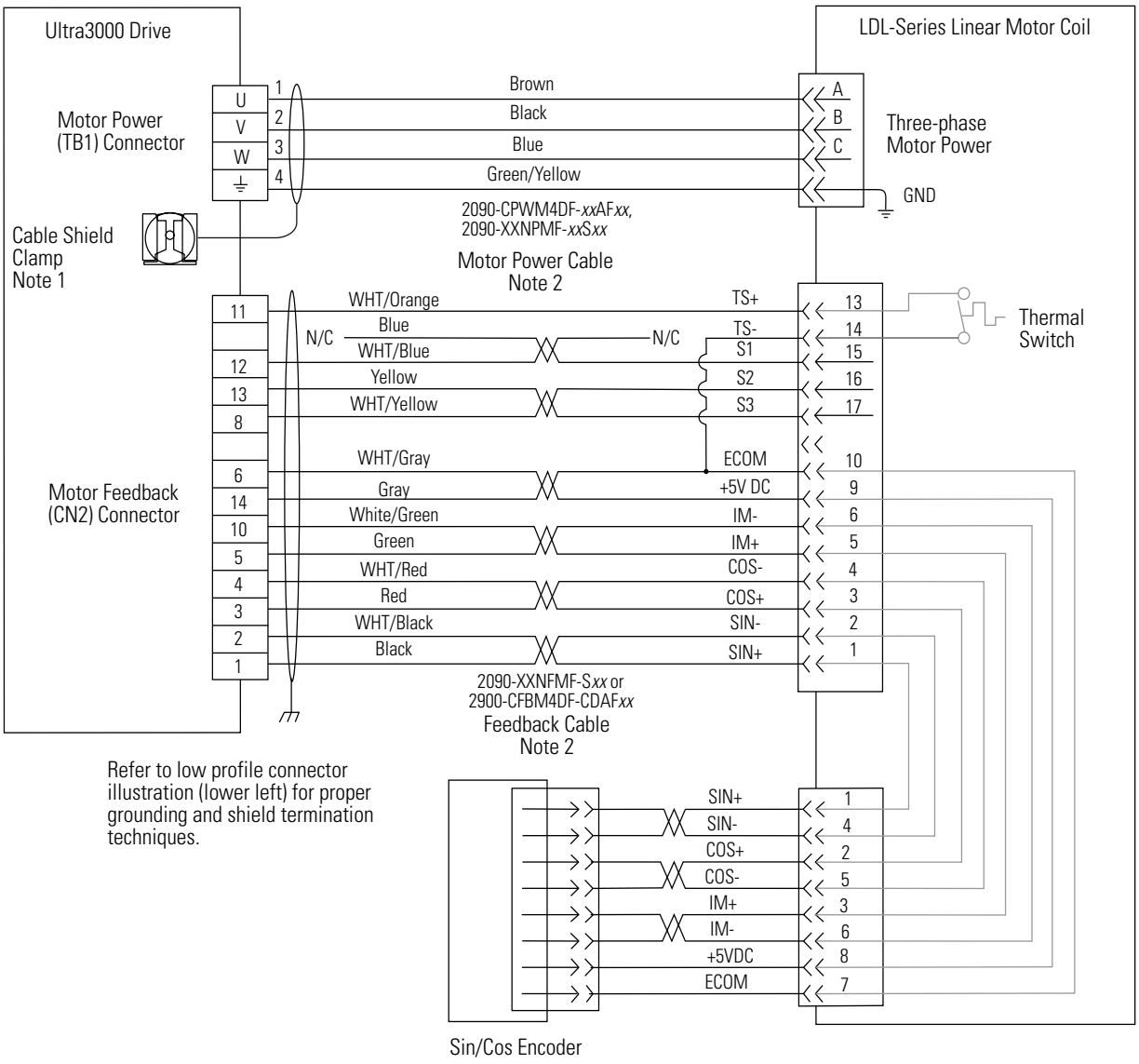
(Use 2090-K6CK-D15M for Kinetix 6000 Drives and 2090-K2CK-D15M for Kinetix 2000 Drives.)

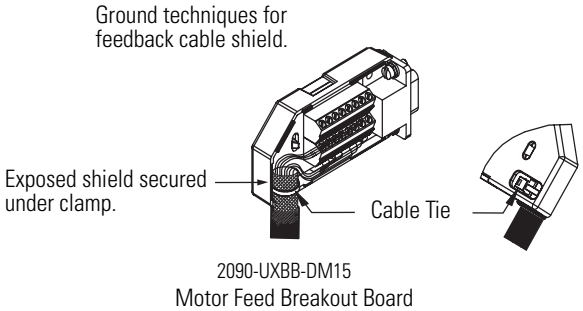
Wiring Example for Ultra Drive and LDL-*xxxxxxx-x*HT11 Linear Motor with a TTL Encoder



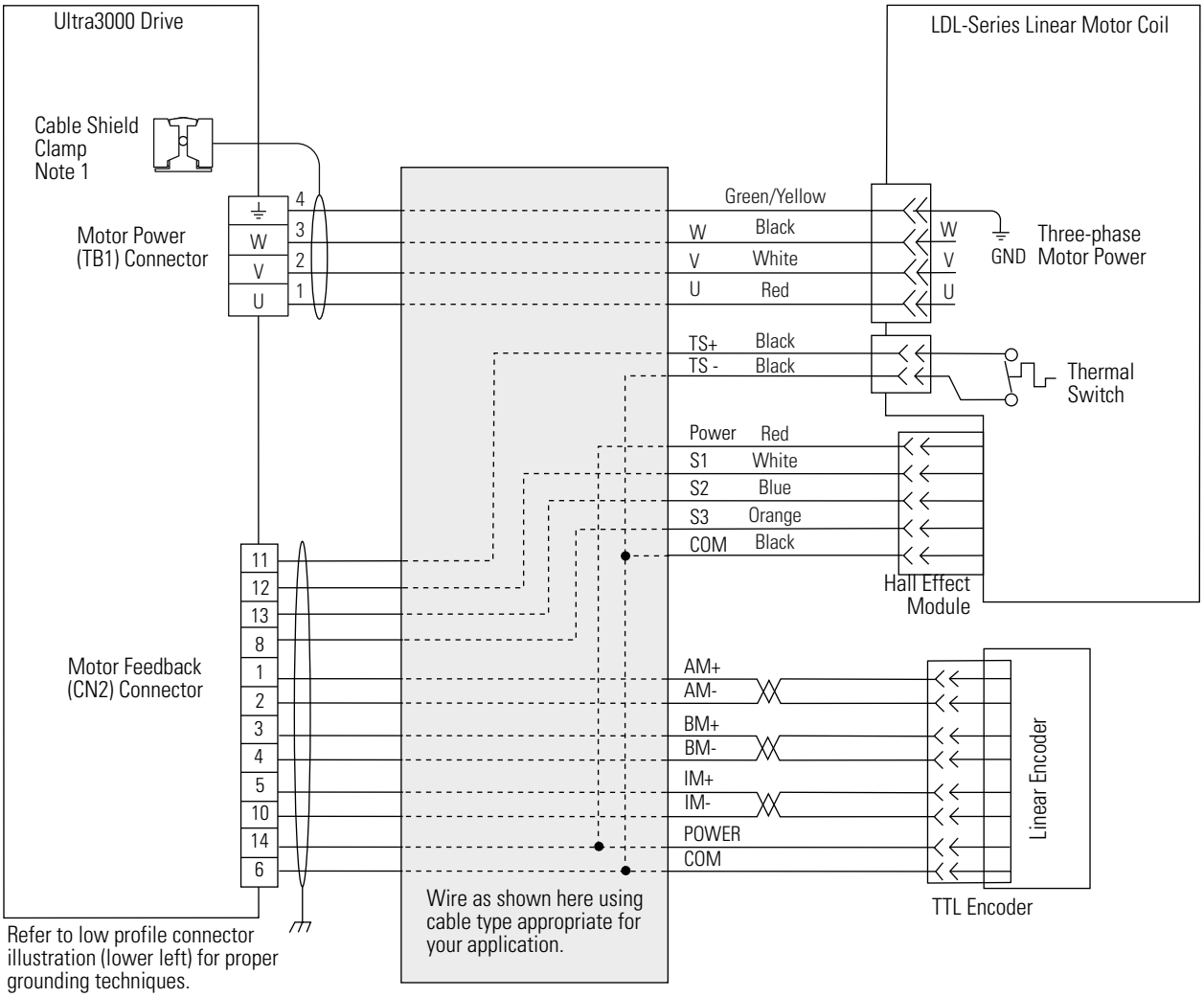


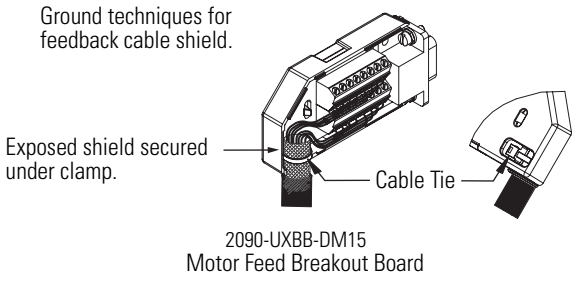
Wiring Example for Ultra3000 Drive and LDL-*xxxxxxx-x*HT11 Linear Motor with a Sin/Cos Encoder





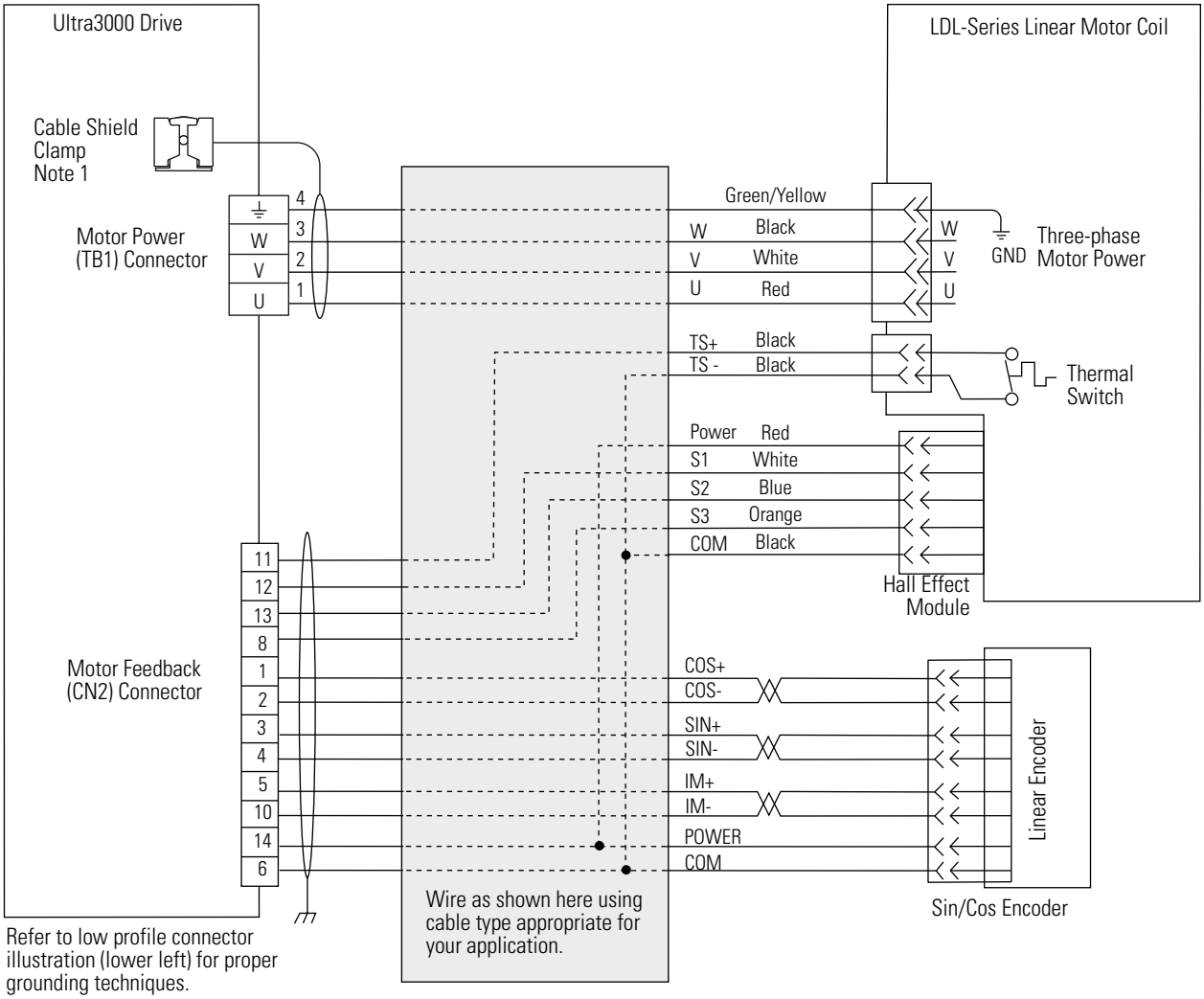
Wiring Example for Ultra3000 Drive and LDL-*xxxxxxx-x*HT20 Linear Motor with a TTL Encoder

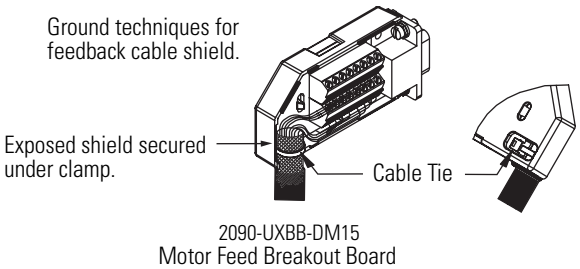




2090-UXBB-DM15
Motor Feed Breakout Board

Wiring Example for Ultra3000 Drive and LDL-*xxxxxxx-x*HT20 Linear Motor with a Sin/Cos Encoder





2090-UXBB-DM15
Motor Feed Breakout Board

Notes:

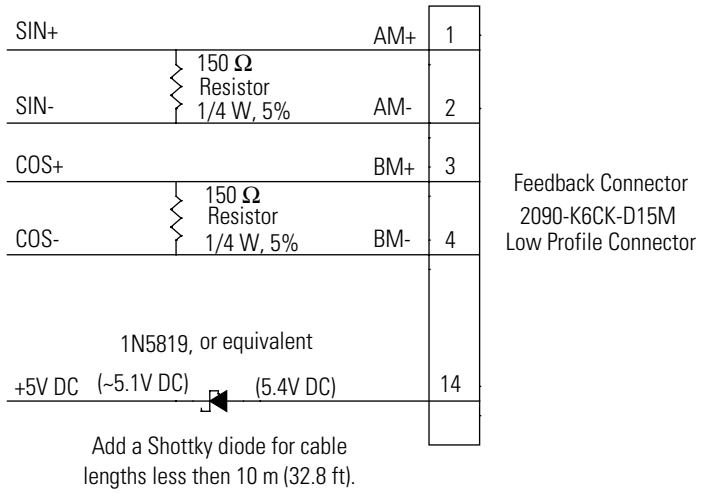
Sin/Cos Linear Encoder and Kinetix 6000 Drives

Introduction

This appendix guides you through commissioning a linear motor with a Sin/Cos 1V peak-to-peak output linear encoder.

Kinetix 6000 Drive Feedback Connection

For robust operation when interfacing your Sin/Cos 1V peak-to-peak differential output linear encoder to a Kinetix 6000 drive, you should terminate the sine and cosine signals as follows.



For systems where the cable length is less than 10 m (32.8 ft), the encoder power supply from the Kinetix 6000 drive feedback connector should be dropped from its nominal 5.4…5.1V DC volts with the addition of a Shottky Diode, see schematic.

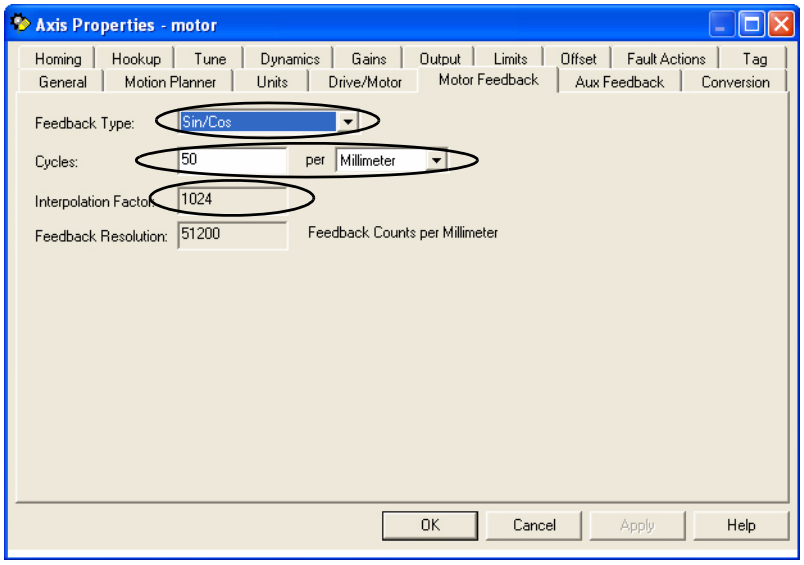
Encoder Counting Direction

Normally, the encoder signals will output sine-leads-cosine (AM leads BM) when the linear encoder head is moving towards its cable, relative to the encoder scale. SERCOS drives count this in a **negative** direction.

Set Up the Axis Properties

When installing a Sin/Cos linear encoder, setup the Axis Property tabs by doing the following.

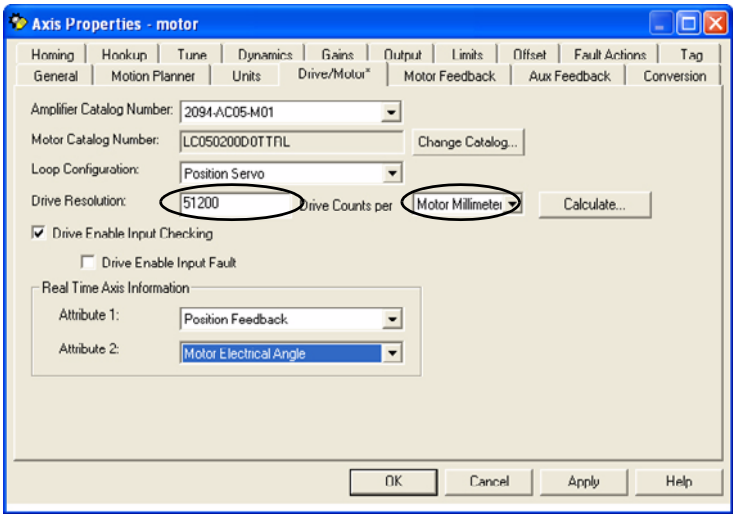
1. Click the Motor Feedback tab.



2. Enter the following parameters.

Parameter	Value	Comment
Feedback Type	Sin/Cos	–
Cycles	25 per Millimeter	For 40 µ pitch encoder scale.
	50 per Millimeter	For 20 µ pitch encoder scale.
Interpolation Factor	1024	–

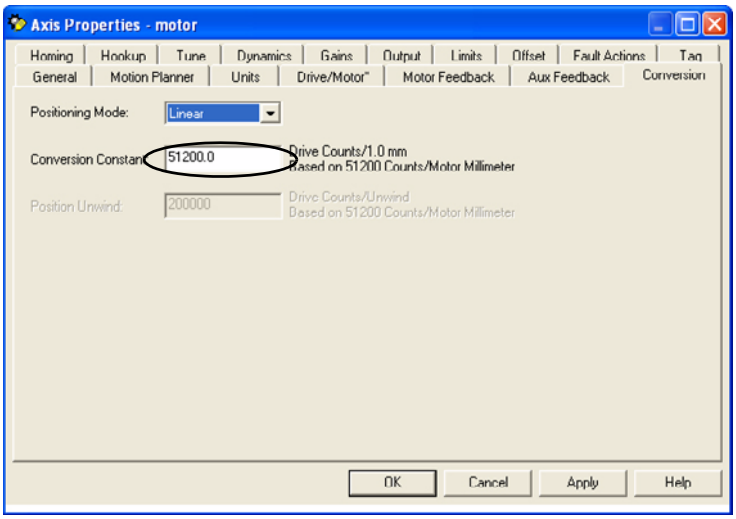
3. Click the Drive/Motor tab.



4. Enter the following parameters.

Parameter	Value	Comment
Driver Resolution	25600	For 40 µ pitch encoder scale.
	51200	For 20 µ pitch encoder scale.
Drive Counts per	Motor Millimeter	–

5. Click the Conversion tab.



6. Enter the following parameters.

Parameter	Value	Comment
Driver Resolution	25600	For 40 µ pitch encoder scale.
	51200	For 20 µ pitch encoder scale.

Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of Faqs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your product up and running.

United States	1.440.646.3434 Monday – Friday, 8 a.m. – 5 p.m. EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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